

OXFORD

India in a Warming World

INTEGRATING
CLIMATE CHANGE AND
DEVELOPMENT

edited by
Navroz K. Dubash

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Integrating Climate Change and Development

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OXFORD
UNIVERSITY PRESS

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Published in India by
Oxford University Press
22 Workspace, 2nd Floor, 1/22 Asaf Ali Road, New Delhi 110 002

Oxford University Press is a department of the University of Oxford.
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First Edition published in 2019

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ISBN-13 (print edition): 978-0-19-949873-4
ISBN-10 (print edition): 0-19-949873-3

ISBN-13 (eBook): 978-0-19-909839-2
ISBN-10 (eBook): 0-19-909839-5

Typeset in Adobe Garamond Pro 11/13
by Tranistics Data Technologies, New Delhi 110 044
Printed in India by Replika Press Pvt. Ltd

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Foreword

The warming of the atmosphere that blankets the earth and makes it habitable is the greatest threat that humanity faces in this century. One happy development is that this statement does not need to be defended at any great length because a consensus on the facts and projections about climate change has been built up over the past three decades. The debate now is increasingly about the actions that need to be taken—by whom and when—both for mitigating the extent of temperature increase and for adapting human societies to the temperature increase that is now unavoidable. This debate has several dimensions.

First, the scientific debate is not entirely over. There is a broad consensus that anthropogenic emissions of greenhouse gases (GHGs) are the principal source of the increases in global temperature that have already been seen and that are projected to take place in the future. However, there are still many uncertainties about some of the parameters used in these projections, the impact of factors like aerosols, the risk of extreme weather events, the variation of impact by region, and the effect of changes in the climate on ecosystems and economic activities. Hence, a continuing process of scientific investigation is necessary.

Second, managing this threat necessarily requires global cooperation because of the planetary nature of the GHG cycles and the worldwide impact of an increase in the average global temperature. A global negotiating process for securing agreement on who does what and when has been underway for about three decades and the outcome remains a work in progress. Climate change has also become a major issue in other global forums, like the G20. Hence, climate diplomacy has become a major feature of international relations.

Third, the fulcrum for action is very much at the national level. The commitments that emerge from climate diplomacy, including, for instance, the nationally determined contributions required under the Paris Agreement of 2015, have to be implemented through changes in national laws and policies. This is particularly true for energy policy which is the centrepiece of climate action programmes. Hence, the debate on the required actions has to connect the global to the national level.

Fourth, the reach of national governments in terms of ground-level action is often limited, and sub-national bodies like provincial governments, municipalities, and local bodies have to be committed to take action. This also has to include non-governmental entities, like corporations, who determine technological choices, products, and processes that will affect climate prospects very directly. Many of these sub-national entities and corporations are developing their own climate action programmes and need to be a part of the policy debate.

Fifth, non-governmental organizations (NGOs) have played a major role in raising awareness and agitating for action at the international level. They have brought to the negotiating table an issue-based commitment, thereby forcing governments to look beyond narrow national interest. This role is particularly important right now when the global agreement does not involve binding commitments but only unilateral national pledges. At the national level, too, these activist NGOs and independent researchers play a crucial role in helping to identify appropriate actions, holding governments accountable, and keeping the long term in focus in development policy debates.

Finally, climate action cannot be separated from other goals of development policy. This is particularly true for adaptation actions directed at coping with temperature changes that are unavoidable, but it also applies to mitigation action. There are often synergies between climate goals and other development goals, like poverty eradication, self-reliance, disaster risk reduction, and so on. Hence, the debate on climate action has to be embedded in the broader debate about development goals and policies.

This book—a collection of separately authored chapters—edited by Navroz K. Dubash, is a very timely contribution to an issue that

is central for development policy today. Though many books keep coming out on the issue of climate change, there is no comparable book dealing with the Indian situation. Its five sections cover all the dimensions of the aforementioned debate.

The opening section on science contains up-to-date material, which presents assessments of impact in India that are not widely known. The section on the international dimension includes some fascinating inside accounts of climate negotiations. The section on politics is particularly helpful on the seminal role of NGOs, as is the one on actions on the challenge of finance and technology transfer, which have played so prominent a role in the global negotiations.

The book presents a good case for integrating climate concerns into development policy and vice versa. The final section deals with the changes that are necessary in three areas relevant both for carbon mitigation and for adaptation (energy, urban development, and forests) and three where the challenge is largely that of adaptation (agriculture, water resources, and coastal areas).

This is a book which should be read by everyone whose primary interest as a researcher, policymaker, or enthusiast is in climate policy or in any one of these sectoral areas. It is also a valuable resource for anyone concerned about the long-term well-being of humanity.

I congratulate the editor and the authors for this valuable contribution which will help to ensure a more informed climate debate in India.

NITIN DESAI

Former Under-Secretary General,
Economic and Social Affairs, United Nations
April 2019

Preface

Climate change and its likely impacts pose an extremely serious challenge to an aspirational India. At the same time, the pathway to productive engagement with the climate change debate is not obvious—India has an excess of urgent and large development challenges and severe constraints on the necessary attention, capability, and resources to address them all. This book aims to bring together the many, and growing, voices that seek to find the language and ideas with which to engage climate change, and to do so from a perspective that resonates with broader Indian development policy discourses. It is intended as an invitation to conversation.

The chapters in this volume are testament to the growing depth and richness of the climate change discussion in India. An earlier edited volume, *Handbook on Climate Change and India*, provided a useful stocktake of the state of the debate in 2012. This volume aims to be similarly comprehensive, but has the benefit of drawing on a much larger and richer base of source material and literature; important new developments on the international stage, such as the Paris Agreement; and voices from a wider range of actors, such as labour unions. In particular, there has been considerably more thinking about how to bring together climate change and development concerns, which is reflected in this volume. It is my hope that the book will provide a useful entry point for academics, students, policymakers, media, business, and civil society seeking to grapple with the complexity of India's climate change conversation.

My deepest thanks go to the contributing authors. They willingly gave their time for an authors' workshop and put up with repeated badgering and demands for shorter, yet more comprehensive and in-depth, treatment of their topics. These authors,

who also represent the most creative edge of India's climate debate, make this book.

My colleagues at the Centre for Policy Research, New Delhi, India, provided intellectual stimulation and contributed to the often-thankless work that goes into producing a large edited volume. Lavanya Rajamani, Radhika Khosla, and Shibani Ghosh shared ideas, reviewed key chapters, and were willing and perceptive sounding boards. Ankit Bhardwaj stepped in willingly to help shepherd critical chapters and, along with Aditya Pillai, helped edit several chapters. Madhura Joshi managed the early part of the book production and organized the authors' workshop. Mandakini Chandra managed communications and outreach and helped in production. Most importantly, this book would not have seen the light of day without Parth Bhatia, who provided research assistance, a close editing eye, and managed the production process. I am deeply grateful to all my colleagues.

The MacArthur Foundation, which stands out for its willingness to support projects that deepen and inform debate, provided funding support for the preparation of these chapters, an author workshop, and the resources with which to make this volume freely accessible. We deeply appreciate this support. The views expressed in this book are those of the contributors and do not reflect the viewpoints of the MacArthur Foundation.

I am grateful to the editors at Oxford University Press, who ably shepherded this book to production.

Finally, the blanket ban by my children on discussion of climate change at the dinner table and my wife's only feeble entreaties to be more supportive of their father forced me to be ever-more creative about ways of raising the issue. For being my toughest but ultimately most-accepting audience, I thank Rinku, Ela, and Rustom.

NAVROZ K. DUBASH

Abbreviations

ACCCRN	Asian Cities Climate Change Resilience Network
ACCMS	Assam Climate Change Management Society
ACT	Action on Climate Today
ADP	Ad Hoc Working Group on Durban Platform for Enhanced Action
AF	Adaptation Fund
AOSIS	Alliance of Small Island States
APA	Ad Hoc Working Group on Paris Agreement
AR4	<i>Fourth Assessment Report</i>
AR5	<i>Fifth Assessment Report</i>
AWG-KP	Ad Hoc Working Group on KP
AWG-LCA	Ad Hoc Working Group on LCA
BASIC	Brazil, South Africa, India, and China
BAU	business-as-usual
BEE	Bureau of Energy Efficiency
BJP	Bharatiya Janata Party
BNEF	Bloomberg New Energy Finance
BUR	Biennial Update Report
C&C	Contraction and Convergence
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CAN	Climate Action Network
CANSA	Climate Action Network South Asia
CASS	Chinese Academy of Social Science
CBDR	common but differentiated responsibilities
CBDR&RC	common but differentiated responsibilities and respective capabilities

CBDR&RC-NC	CBDR&RC in the light of different national circumstances
CBGA	Centre for Budget and Governance Accountability
CCFU	Climate Change Finance Unit
CDC	Contract and Differential Convergence
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CEEW	Council on Energy, Environment and Water
CEOs	chief executive officers
CERs	certified emission reductions
CERC	Climate Equity Reference Calculator
CERF	Climate Equity Reference Framework
CFCs	chlorofluorocarbons
CFR-LA	Community Forest Rights–Learning and Advocacy
CII	Confederation of Indian Industry
CJN!	Climate Justice Now!
CMFRI	Central Marine Fisheries Research Institute
COP	Conference of the Parties
CPIM5	Coupled Model Intercomparison Project Phase 5
CPR	Centre for Policy Research
CRM	climate risk management
CRZ	Coastal Regulation Zone
CSE	Centre for Science and Environment
CSOs	civil society organizations
CSO	chief sustainability officer
CSR	corporate social responsibility
CSTEP	Center for Study of Science, Technology & Policy
CTCN	Climate Technology Centre and Network
CTF	Clean Technology Fund
DALYs	disability-adjusted life years
DFID	Department for International Development
DISCOMs	distribution companies
DPRs	Detailed Project Reports
DSF	Delhi Science Forum

EC	European Community
ECBC	Energy Conservation Building Code
ECCC	Executive Committee on Climate Change
EESL	Energy Efficiency Services Limited
EHS	environment, health, and safety
EMPRI	Environmental Management and Policy Research Institute
ENSO	El Nino Southern Oscillation
EPCO	Environmental Planning and Coordination Organisation
ESMAP	Energy Sector Management Assistance Program
ETS	Emissions Trading Scheme
EU	European Union
FAO	Food and Agricultural Organization
FERAL	Foundation for Ecological Research, Advocacy and Learning
FICCI	Federation of Indian Chambers of Commerce and Industry
FoR	Forum of Regulators
FRA	Forest Rights Act, 2006
FRAD	Fishery Resources Assessment Division
FSI	Forest Survey of India
GCF	Green Climate Fund
GCMs	general circulation models
GDP	gross domestic product
GDR	Greenhouse Development Rights
GEF	Global Environment Facility
GHGs	greenhouse gases
GIM	Green India Mission
GMBM	global market-based measures
GoI	Government of India
GRI	Global Reporting Initiative
GST	Global Stocktake
Gt	gigatonne
GW	gigawatt
GWP	global warming potential
HCFCs	hydrochlorofluorocarbons
HDI	human development index

HFCs	hydrofluorocarbons
HFO	hydrofluoroolefin
HKH	Hindu Kush Himalaya
HPEC	High Powered Expert Committee
HVAC	heating, ventilation, and air conditioning
ICAO	International Civil Aviation Organization
ICRG	Infrastructure for Climate Resilient Growth
ICSA	International Coalition for Sustainable Aviation
ICTSD	International Centre for Trade and Sustainable Development
IEA	International Energy Agency
IESS	India Energy Security Scenarios
IGSD	Institute for Governance and Sustainable Development
IIASA	International Institute for Applied Systems Analysis
IITM	Indian Institute of Tropical Meteorology
IL&FS	Infrastructure Leasing & Financial Services Limited
IMD	India Meteorological Department
INC	Intergovernmental Negotiating Committee
INCCA	Indian Network for Climate Change Assessment
INCFCCC	Intergovernmental Negotiating Committee for a Framework Convention on Climate Change
INDC	Intended Nationally Determined Contribution
IP	intellectual property
IPCC	Intergovernmental Panel on Climate Change
IPRs	intellectual property rights
IRENA	International Renewable Energy Agency
ISA	International Solar Alliance
ITUC	International Trade Union Confederation
JFM	Joint Forest Management
JUSCANZ	Japan, United States, Canada, Australia, and New Zealand
kgoe	kilograms of oil equivalent
KP	Kyoto Protocol
KSSP	Kerala Shashtra Sahitya Parishad

kV	kilovolt
kWh	kilowatt hour
LAPCC	Lakshadweep Action Plan for Climate Change
LCA	long-term cooperative action
LCOE	levelized cost of electricity
LDCs	least developed countries
LDCF	Least Developed Countries Fund
LEAD	Leadership for Environment and Development
LED	light-emitting diode
LMDC	Like-Minded Developing Countries
LPCD	litre per capita per day
LPG	liquefied petroleum gas
LULUCF	land use, land use change, and forestry
MDBs	multilateral development banks
MEF	Major Economies Forum
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MI	Mission Innovation
MLF	Multilateral Fund
MNRE	Ministry of New and Renewable Energy
MoC	Ministry of Coal
MoEF	Ministry of Environment and Forests
MoEFCC	Ministry of Environment, Forest and Climate Change
MoF	Ministry of Finance
MoP	Ministry of Power
MoUD	Ministry of Urban Development
MoWR	Ministry of Water Resources
MRV	measurement, reporting, and verification
MSME	micro, small, and medium enterprise
MtCO ₂ -eq	megatonne of carbon dioxide equivalent
MTEE	Market Transformation for Energy Efficiency
mtoe	million tonnes of oil equivalent
MW	megawatt
NAAS	National Academy of Agricultural Sciences
NABARD	National Bank for Agriculture and Rural Development
NAFCC	National Adaptation Fund on Climate Change

NAPCC	National Action Plan on Climate Change
NASA	National Aeronautics and Space Administration
NATCOMs	National Communications
NBFCs	non-banking financial companies
NCEEF	National Clean Energy and Environment Fund
NCR	National Capital Region
NDA	National Democratic Alliance
NDA _s	national designated authorities
NDC	Nationally Determined Contribution
NEMMP	National Electric Mobility Mission Plan
NGOs	non-governmental organizations
NIE	National Implementing Entity
NMEEE	National Mission on Enhanced Energy Efficiency
NRDC	Natural Resources Defense Council
NSA	National Security Advisor
NSCCC	National Steering Committee on Climate Change
NSM	National Solar Mission
NTFPs	non-timber forest products
NTUI	New Trade Union Initiative
NUMSA	National Union of Metal Workers of South Africa
NWM	National Water Mission
ODA	official development assistance
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
OPM	Oxford Policy Management
PAIRVI	Public Advocacy Initiatives for Rights and Values in India
PAT	Perform–Achieve–Trade
PES	payments for ecosystem services
PIB	Press Information Bureau
PMCCC	Prime Minister’s Council on Climate Change
PMO	Prime Minister’s Office

PMU	Project Management Unit
PMUY	Pradhan Mantri Ujjwala Yojana
PNG	piped natural gas
PPAs	power purchase agreements
PSI	People's Science Institute
PSU	public-sector undertaking
PTI	Press Trust of India
PV	photovoltaic
QELRO	quantitative emission limitation and reduction objective
R&D	research and development
RD&D	research, development, and demonstration
REDD	reducing emissions from deforestation and degradation
RMI	Rocky Mountain Institute
RTK	revenue tonne kilometres
S&L	standards and labelling
SAPCCs	State Action Plans on Climate Change
SCCF	Special Climate Change Fund
SDC	Swiss Agency for Development and Corporation
SDGs	Sustainable Development Goals
SDMP	State Disaster Management Plan
SEBs	state electricity boards
SEEP	Super-Efficient Equipment Programme
SIDS	Small Island Developing States
SPV	special purpose vehicle
SSEF	Shakti Sustainable Energy Foundation
SST	sea surface temperature
STPs	sewage treatment plants
TCFD	Task Force on Climate-Related Financial Disclosures
TEC	Technology Executive Committee
TERI	The Energy and Resources Institute
TGSC	Tata Global Sustainability Council
TISS	Tata Institute of Social Sciences
TNAs	Technology Needs Assessments
TUED	Trade Unions for Energy Democracy

xxvi Abbreviations

TWh	terawatt hour
UDAY	Ujwal DISCOM Assurance Yojana
UEA	University of East Anglia
UJALA	Unnat Jyoti by Affordable LEDs for All
ULBs	urban local bodies
UN	United Nations
UN DESA	United Nations Division of Economic and Social Affairs
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNES	United Nations Economic and Social
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UPA	United Progressive Alliance
WBCSD	World Business Council for Sustainable Development
WBGU	German Advisory Council on Climate Change
WCMC	World Conservation Monitoring Centre
WEF	World Economic Forum
WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
WTO	World Trade Organization

An Introduction to India's Evolving Climate Change Debate

From Diplomatic Insulation to Policy Integration

Navroz K. Dubash

Climate change has been evocatively described as a 'wicked' problem—it has no unambiguous definition, is riven with scientific uncertainty, and proposed solutions are complicated by their embedding in social, political, and economic systems (Hulme 2009). If climate change is an environmental issue for some people, for others it is predominantly about justice and equity, and for yet others, it is largely an economic and technical challenge. In contrast with 'tame' problems, even the problem definition is fraught, and, therefore, how we discuss and debate climate change is a challenge; differences in interests are further confounded by differences in interpretation. As a result, even as evidence mounts that climate change could result in a near-unliveable 'hothouse earth', raising the spectre of an existential dilemma (Steffen et al. 2018), action on climate change proceeds at a glacial pace, seemingly embedded in endless and protracted debate.

2 An Introduction to India's Evolving Climate Change Debate

From an Indian perspective, the challenges of productively engaging with the climate change debate are further amplified for both pragmatic and political reasons. Pragmatically, India faces enormous, and immediate, challenges of lifting its citizens out of poverty; providing access to basic needs such as health, education, energy, and water and sanitation; and addressing governance challenges of corruption and communal tensions. By comparison, climate change appears less immediate, less certain, and therefore, less of a priority. Politically, there is a long-standing perspective that India has contributed relatively little to causing the climate problem and should not be asked to be in the forefront of solving it. India's contribution to the stock of emissions that has built up in the atmosphere is low, and its emissions per person are far lower than the global average.

Despite these complications, there is an overarching reason why India should, indeed, find ways of productively engaging with the climate debate: a development path that is innocent of climate change is no longer possible. The impacts of climate change will increasingly threaten development outcomes, as the chapters in this book show comprehensively. Also, a growing range of development decisions, including but not limited to energy, will have to account for a global context shaped by climate politics and policymaking. There are at least three ways in which this interplay between climate and development demands Indian attention.

First, India is a country that is deeply vulnerable to climate impacts. Put more starkly, potential climate impacts are sufficiently large that they could serve as a barrier to fully achieving India's development aspirations. As chapters in this volume explore, climate change can disrupt agricultural systems, water availability, forest health, and coastal ecology, thereby affecting the lives and livelihoods of millions. From a climate impacts perspective, the success or failure of global efforts to address climate change is deeply salient to India's interests, particularly to those of its poorest citizens.

Second, development-focused actions and interventions are closely intertwined with climate change-related objectives. For example, air pollution-related policies may also reduce greenhouse gas (GHG) emissions and more efficient use of water can not only enhance development outcomes but also climate resilience. Notably,

these interactions may not always be positive; there may also be trade-offs between development and climate objectives. Whether positive or negative, the interactions between climate and development are widely present. Development innocent of climate change implications is not an option.

Third, climate change is salient to India's engagement with other countries and the global community, with implications for India's energy economy and foreign policy. India's energy economy is strongly shaped by global context through energy trade and technology development patterns. Climate change is highly likely to affect energy prices across different supply sources, as well as patterns of investment in research and development, both with implications for India's energy planning. Moreover, climate change as a foreign policy issue is rising up in the global agenda, and India's engagement with the issue is material to its aspirations as a rising power.

Notably, focusing on these issues of vulnerability, potential synergies between climate and development, and foreign policy helps address India's concerns about being held responsible unfairly for addressing climate change, despite the problem being largely caused by others. Given India's vulnerability to climate change, India's interests lie in promoting effective global cooperation to address climate change. With low per capita and historical emissions, India may not have a responsibility *for* climate, but as the third largest annual emitter it may have a responsibility *to* vulnerable populations to engage climate change. This need not mean that India prioritizes climate action over development. As climate actions are not always costly to development actions but sometimes complementary, a possible path forward exists for India to engage with both climate and development productively.

Finally, India's foreign policy aspirations as a responsible power require not just that India is part of the solution but is *seen* to be part of the solution. Collectively, these themes provide a possible answer to why India should devote some attention to climate change, even in the face of pressing domestic concerns.

They also provide a focus for how India should address climate change, which also motivates the subtitle for this book: integrating climate change and development. In both concept and practice,

this is not an easy task. Over the course of the past decade, a past construction of climate change as a largely diplomatic problem has given way to one that takes more seriously this question of integrating climate change and development. For example, Indian science has begun to grapple with climate impacts; Indian negotiators have begun internalizing this approach into their diplomacy; civil society, business, and labour have reframed their work using this language; policymakers have sought to internalize this integration into their policies; and sectoral experts have sought to understand how this integration would occur in particular sectors.

The central objective of this book is to find useful ways of talking about climate change in India and by so doing, explore ways in which to productively engage and act on the climate change challenge. Through these chapters, we hope to deepen clarity both on why India should engage climate change and how it can best do so, even while appreciating and representing the challenges inherent in doing so.

Approach

This collection is designed to encourage public debate and deliberation on climate change as part of India's larger development discourse. As a result, each chapter is meant to provide an accessible entry point to a topic. The chapters do this by developing a conceptual road map for key issues in the climate debate, with the intention of providing readers the concepts and ideas necessary to follow and participate in debates. Frequently, this approach requires laying bare disagreements or differing perspectives, rather than proclaiming premature unanimity. More than a primer then, the aim is to invite readers into a conversation even when, and perhaps particularly when, the topic is messy and issues are conflicted.

While the amount of writing on climate change and India has increased sharply in recent years, much of this writing is specialized in particular areas, such as energy policy, foreign policy, or climate negotiations. Moreover, a great deal of knowledge rests with practitioners of various sorts, who may not typically have the time or inclination to put down their ideas in writing for a broader audience. Of the existing literature, an earlier *Handbook of Climate Change and*

India attempted the most comprehensive review then available of climate negotiations and domestic politics and policy, but since all these areas have transformed significantly in the interim, much of this material requires updating (Dubash 2012b). Another set of volumes aims at providing a critical perspective on Indian climate policy: in one case, an edited collection by activists (Dutta 2013), and another by a journalist (Bidwai 2012, 2010). Other volumes are more specialized, focusing on India's role in negotiations (Saran and Jones 2016), modelling India's emissions (Shukla, Garg, and Dholakia 2015), or reviewing impacts and adaptation (Chattopadhyay 2014). This collection builds on these past works, and aims to systematically collate the work of experts as well as harvest the work of specialists whose work is not widely available.

To this end, the chapters are of two types. Most chapters are written as even-handed reviews of an issue, aiming to present multiple perspectives on an issue. Authors undoubtedly have a viewpoint, but they present this after laying out the range of different opinions and analyses on an issue. Review chapters are written by experts, with a wide range of expertise represented: law, economics, environmental studies, sociology, science and technology studies, atmospheric science, and political science among them. Since climate change is a fast-moving topic, the review chapters are also written to transcend short-term developments and focus on providing a conceptual framework that readers can draw on in engaging an issue.

The second type of chapters present perspectives on an issue, identified as such by their subtitles, and are typically written by practitioners to lay out important positions in discussions. These practitioners include diplomats, including leaders of India's climate delegation at various times, business people, labour activists, and consultants. The mix of review and perspective chapters is aimed at providing the reader a rounded entry point to various debates around climate change and India.

The volume is divided into five thematic sections: climate change impacts; international debates and negotiations; politics; policies; and climate and development. While this book is focused on social scientific understandings of climate change, a necessary starting point is an understanding of what climate science suggests we know about impacts in India. Some aspects of the science are also covered

in Chapters 24–29 focused on particular sectors, in the climate and development section. Climate negotiations have historically dominated climate discourse. While chapters on this topic adequately cover developments in climate negotiations, notably the build-up to the implications of the Paris Agreement, this section of the book occupies only about a third of the volume.

The majority of the book is devoted to national developments, where a great deal of ferment has occurred in recent years. The volume provides three different entry points to these developments. One approach is to explicitly look at the shifting politics around climate change by examining the perspectives of different political actors—environmentalists, business, and labour—and reviewing themes in Indian print media reports on climate change. Another entry point is to specifically examine emergent policies around climate change at multiple scales—national and state—and in key cross-cutting areas, particularly finance and technology. Climate policy developments at the city scale are addressed separately in Chapter 25.

A final section provides the third entry point and speaks most directly to the central theme of this book: integrating climate change and development. While many treatments of climate change are divided into mitigation (or emissions reduction) and adaptation, this volume follows a sectoral logic. The reason is that in India, as in many other places, governance and institutions remain organized around sectors, such as energy, agriculture, urbanization, forests, and coasts, and there is no cross-cutting structure of climate governance. The chapters in this section examine the implications of climate change for objectives in these sectors, and whether and how mainstreaming climate change into sectoral plans and policies has been discussed and implemented.

The remainder of this 'Introduction' provides a substantive entry point to each of these sections. I describe the intellectual rationale for the contributions, set them in context, and highlight links across chapters.

Climate Change Impacts

The volume starts with three chapters on the potential impacts of climate change, which is a necessary starting point for discussion

on climate politics, policy, and governance. Notably, this section, and the book, does not explicitly cover the underlying science of climate change and the complex interaction between the biosphere and human patterns of economic activity that are changing the climate. An interested reader is best served by referring to the various reports of the Intergovernmental Panel on Climate Change (IPCC), in order to better understand these scientific issues. For the purposes of this volume, this section lays out three perspectives on climate impacts on India, respectively, focused on observed and future impacts, evidence of linkage between climate change and specific events, and narratives of impact on human and animal life.

To begin with, Srinivasan, in Chapter 2, provides an overview of what we know about likely climate impacts on India and, equally important, what we do not know, as yet, with much certainty. His chapter addresses both observed and potential future impacts, projected with the assistance of complex climate models. Notably, Srinivasan also explains the methods of climate science—how we know what we know. He highlights that there is clear evidence from the twentieth-century record that India's climate is changing and that this change is likely to accelerate. Impacts such as extreme rainfall, more severe heatwaves, and longer dry spells are all likely, although information on rainfall, critical for monsoon-dependent India, is less reliable than for temperature. While enhanced effects are highly likely, climate models are not sufficiently advanced to predict regional impacts as yet, which are necessary for design of local adaptation programmes.

An emergent science of attribution studies seeks to go further than explaining broad aggregate impacts, by exploring the likelihood that any given weather event—such as a flood or heatwave—is due to global climate change versus other, perhaps local, environmental drivers. The potential implications of this new science are profound; they could transform climate change from an abstract concept to one linked to tangible impacts and could even open the door to claims for legal damages from weather impacts. In Chapter 3, AchutaRao and Otto review the (so far very limited) India-specific evidence available from attribution studies. While globally two-thirds of attribution studies find some role for climate change in explaining

extreme events such as droughts, heavy rainfall, and heatwaves, the evidence available for India is much thinner as yet. Of the three cases reviewed, they find that climate change is definitely the main driver of impacts in one of the three case studies available—a heatwave in Andhra Pradesh that was made 25 times more likely to occur by climate impacts—but not so in the other two. They stress that these studies measure climate effects as of now, and not future climate effects as GHGs increase as is projected. This science is in its infancy, particularly in India, and will undoubtedly sharpen discussion and debate on climate impacts as it advances.

Chapter 4 by Adve is intended precisely to address the often-abstract nature of climate impacts. Writing with a view ‘from-below’, Adve explores existing stories of the potential impacts of climate change as they are experienced in people’s lives. While a direct link cannot be assumed between any potential impact and climate change without the benefit of a positive attribution study, Adve’s work illustrates the human effects of the sorts of impacts that climate science predicts will get more likely to occur. As such, it helps in engagement with climate change and its likely impacts by relating them to lived experience. The areas he covers include displacement due to sea-level rise, species migration, and effects on Himalayan ecosystems.

In addition to these chapters, sector-specific impacts on water, forests, and coasts are also discussed in the relevant chapters in Section V. Collectively, these chapters help reinforce the reality that climate change will have serious impact on India, and in some cases is already doing so, and help translate this seemingly abstract issue to the realities of India’s citizens, particularly the most vulnerable among them.

International Debates and Negotiations

Climate change has typically been framed as a global collective action problem. Since GHGs emitted anywhere have a warming effect everywhere, no reduction by any single country (with the possible exception of the two giants—China and US) has a significant effect on climate outcomes. Every country’s actions towards mitigation is only meaningful in the context of every other country’s actions. But

if every country has to act, then how much mitigation action should each take and how is that to be decided? The first two decades of global climate politics, and India's engagement in it, has revolved around this question.

This question of which country does how much, and how fast, is closely tied to competing and contending interpretations of GHG emission numbers of various countries and how they change over time. Understanding these debates is important to understanding India's role in global climate politics. As Figure 1.1 shows, India has contributed very little to the cumulative build-up of GHGs over time in the atmosphere because it is a late developer (due to data limitations, only carbon dioxide [CO₂] emissions excluding land use change are reported in Figure 1.1). Moreover, as a poor country, it has relatively low GHG emissions per capita that were, even in 2014, well below the global average (Figure 1.2). On the other hand, in terms of total annual emissions emitted, by 2014 India was the third-largest emitter, albeit a long way behind China and the US, and is also among the more rapidly growing (Figure 1.3).

These various formulations of the data illustrate the political challenge: what is reasonable to expect of each country differs based

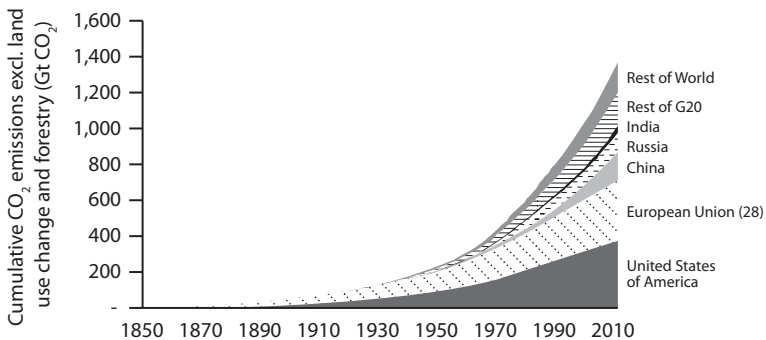


Figure 1.1 Cumulative CO₂ Emissions Excluding Land Use Change and Forestry (1850–2014)

Source: CAIT Climate Data Explorer (2018).

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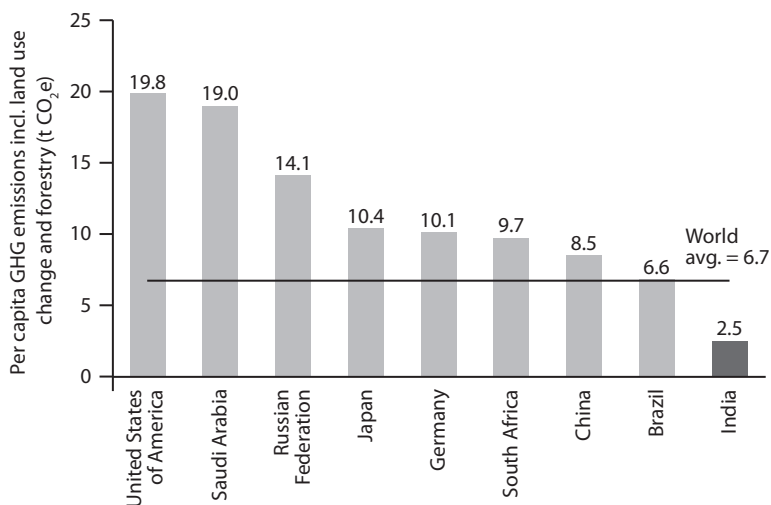


Figure 1.2 Per Capita GHG Emissions Including Land Use Change and Forestry in tCO₂e (2014)

Source: CAIT Climate Data Explorer (2018).

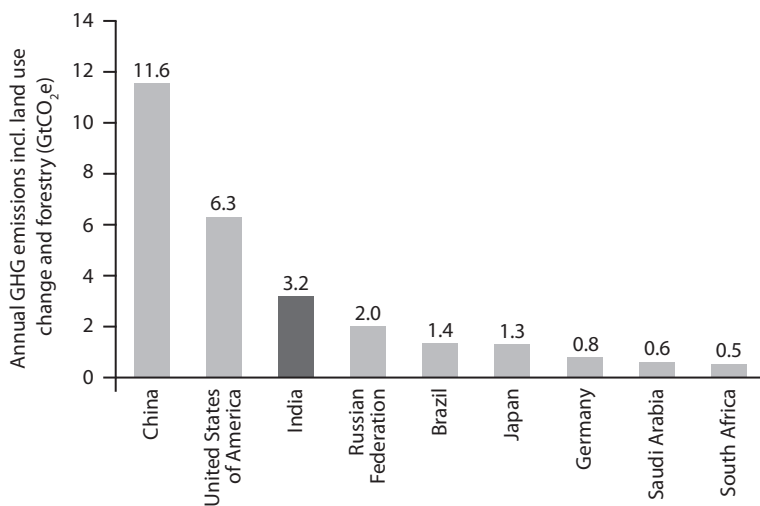


Figure 1.3 Annual GHG Emissions Including Land Use Change and Forestry in GtCO₂e (2014)

Source: CAIT Climate Data Explorer (2018).

on how the data is sliced and represented. However, they also illustrate the dilemma from an Indian perspective: it is simultaneously true that India has little responsibility for past emissions but it is likely to contribute a large share of future emissions, and is therefore material to future efforts to solve climate change. As the third-largest emitter, a global political resolution to the collective action problem is unlikely without India. This low responsibility for past accumulations and low capacity to address the problem, coincident with India's relatively large share of current emissions, has strongly shaped India's role in global climate politics.

The first two chapters in this section explicate this dilemma. In selected excerpts from a foundational 1991 article, Agarwal and Narain argue in Chapter 5 that mathematical jugglery with numbers has resulted in developing countries like India being burdened unfairly with responsibility for addressing climate change. Their article was deeply influential in shaping perceptions of climate change as a fraught diplomatic challenge, one that has climate equity at its core and that requires diplomatic watchfulness if India is not to be unfairly blamed for this problem or bear unfair costs in trying to resolve it.

Over the years, the debate over both concepts and numbers around climate equity has expanded greatly. In Chapter 6, Kanitkar and Jayaraman review this literature, explaining key concepts, such as the important principle of 'common but differentiated responsibilities and respective capabilities' (CBDR&RC) (also see Rajamani 2012), and explaining that when it comes to a mitigation burden, it is important to discuss both what is to be divided among countries and how it is to be divided. The chapter concludes by revisiting climate equity in light of the Paris Agreement.

The next cluster of six chapters squarely deals with climate negotiations. This sequence of chapters captures an important broadening in the conceptualization of climate change as well as the architecture of negotiations. While the global collective action construction of climate change remains salient and important, an emergent strand of literature suggests that it may also usefully be thought of as amenable to 'polycentric' approaches—multiple actions at diverse scales—that are an important complement to global action (Jordan et al. 2018; Ostrom 2010). This conceptual plurality has taken shape internationally in the form of the Paris Agreement of 2015, which combines

'bottom-up' national pledges, which could be thought of as unleashing polycentric action, with complementary 'top-down' elements that are intended to enhance transparency of national pledges and ratchet them up over time. Understanding the recent history of climate negotiations requires understanding this shift, and the politics that led to it.

In Chapter 7, Sengupta provides the long view, explaining the arc of the international negotiation process and India's shifting role in climate negotiations from the early days of the United Nations Framework Convention on Climate Change (UNFCCC) to the Paris Agreement. He explains, for example, India's reluctance to embrace the Clean Development Mechanism—allowing a country to invest in carbon reduction in another country and win carbon credits—followed by its enthusiastic future adoption of the approach. He also tracks the shifting politics of climate change in India and how this aggregated, over time, to an India that was willing to strike a deal at Paris.

Three remarkably candid accounts by India's lead negotiators at Rio (1992), Copenhagen (2009), and Paris (2015) follow. What jostling for position was occurring and hidden or not-so-hidden signals being sent in the weeks before these critical negotiations? What efforts were made to reinforce alliances? Why, ultimately, did India make the calls that it did? These inside perspectives by those best placed to know India's stance shine light on these questions. In Chapter 8, Ambassador Dasgupta, discussing the making of the UNFCCC in the build-up to the foundational negotiations in Rio de Janeiro in 1992, explains how key principles were hard-fought for and won to preserve India's interest in climate equity. Ambassador Saran, in Chapter 9, takes the reader through the tortuous negotiations between US President Obama and the leaders of the four 'BASIC' countries—Brazil, South Africa, India, and China—in an effort to strike a deal in Copenhagen in 2009. He also explains how India, and other developing countries, argued strongly for placing finance and technology on the table, and how this issue was sought to be made a point of leverage by some industrialized countries. Discussing the landmark Paris negotiations of 2015 in Chapter 10, Lavasa explains the conditions that allowed India to reshape its international reputation, an unfair one, he argues, as a

potential spoiler to being an enabler of the Paris Agreement. He also discusses India's proactive efforts to project its forward-looking initiatives, such as accelerating renewable energy adoption, as key shapers of this image.

As a counterpoint to these insider views, in Chapter 11, Raghunandan provides critical view from the outside on India's approach to negotiations, drawing on his long experience as an analyst and activist on climate negotiations and policy. He probes, for example, whether India's negotiation stance is consistent with science and with India's domestic interests. He suggests that India has not adequately pursued the interests of its climate-vulnerable population, failing to fully support an ambitious global agreement. Instead, he argues, foreign policy considerations especially focused on its relationship with the US, as opposed to India's climate-focused interests, play a disproportionate role in shaping India's negotiating stance.

Two further chapters examine the Paris Agreement and the legal and political process of reaching this agreement. In Chapter 12, Rajamani draws on her long engagement as a legal scholar and practitioner to explain how the Paris Agreement marks a substantial departure from earlier legal instruments on climate change, and describes how this transition occurred. She explains the shift in terms of the architecture of the agreement—a hybrid of bottom-up and top-down—the legal form of the agreement and the legal character of its provisions, and shifts in the key concept of differentiation between groups of countries. In these ways, she suggests, the Paris Agreement did mark an innovation in climate and, indeed, international law.

Mathur, in Chapter 13, provides an important perspective on Paris, from the perspective of someone who brings both insider knowledge of negotiations and an outside eye as a researcher. He explains how Paris provided a pragmatic way for the world, and for India, to move forward with climate action. He suggests that the Paris Agreement introduces a learning-by-doing dynamic that, over time, will build a virtuous cycle of trust between countries.

These chapters provide a useful entry point to what is a robust debate beyond the pages of this volume about the benefits and costs of the Paris Agreement for India. Some condemn what they see as

its core bottom-up approach built around 'Nationally Determined Contributions' (NDCs) as inadequate, and worry that it will perpetuate climate inequalities (Narain 2015; Sethi 2015). Others suggest that India's interests were reasonably well served at Paris, as a result of a series of carefully calibrated compromises, even while its ultimate effectiveness awaits realization (Dubash 2017). Across countries, the global climate regime, including the Paris Agreement, has expanding international participation in climate governance; for example, a recent study finds that, by 2017, 89 per cent of GHGs were covered by an emissions target and 70 per cent by some form of climate legislation or strategy (Iacobuta et al. 2018). Whether these measures, by generating a virtuous cycle that Mathur describes, can compensate for the relative weakness of top-down measures will only become apparent over time.

Climate negotiations do not occur only under the auspices of the UNFCCC. Increasingly, the climate arena resembles a 'regime complex' (Keohane and Victor 2011), with sub-negotiations in different forums and under different rules. In the last chapter in this section (Chapter 14), Ghosh takes us through two such important negotiations: limits on hydrofluorocarbons (HFCs) under the Kigali Amendment to the Montreal Protocol and a new global market-based measures approach on aviation emissions. He also notes, by taking the reader through the process, that India departed from its usual negotiation style on occasion during these processes, particularly the negotiations on limits on HFCs, including on key issues such as differentiation.

Collectively, the chapters in this section tell the story of an international climate process that has been substantially transformed over the last decade. They also explain how India has worked, and on occasion struggled, to retain and rearticulate its interests in this emergent landscape. From a relatively narrow focus on principles of equity and differentiation, India has explored more nuanced views around several key negotiation issues. These include, in particular, openness to more diffused approaches to differentiation in the Paris Agreement and HFC negotiations and agreement to a legal requirement to submit regular national pledges, both of which were critical to a global deal. There remain debates within India on whether these are progressive or regressive shifts, and

on the overall effectiveness of the global climate regime. But in a shifting and fluid environment of global climate politics, there is certainly scope for India to play a larger role in determining global cooperation outcomes.

Politics

A stylized description of domestic Indian climate politics around the time of the 2009 Copenhagen climate negotiations described three broad perspectives: ‘growth-first realists’ who advocate economic growth, staving off international pledges, and who see climate change as a geostrategic issue rather than an immediate threat to India; ‘sustainable-development realists’ who take seriously challenges of sustainable development and climate change, but who are deeply sceptical of the international process; and ‘sustainable-development internationalists’ who take seriously sustainability and climate concerns and see India’s interests lying in furthering global cooperation, including through enhanced Indian action (Dubash 2012a). All three positions have historically been simultaneously present in public debate, but in the years from Copenhagen in 2009 to Paris in 2015, there has been greater openness to an internationalist stance (Dubash et al. 2018).

Shifts in India’s negotiating approach are very likely rooted in shifts in domestic politics. Underlying factors driving this shift include more information on India’s vulnerability to climate impacts, greater appreciation of the potential synergies between climate and development policies, and a heightened concern with geopolitical perceptions of India as a cooperative player on climate change (Atteridge et al. 2012; Dubash 2013; Michaelowa and Michaelowa 2012; Sengupta 2012; Vihma 2011). At the same time, attention to climate change as an electoral issue does not appear to be growing. Indeed, the last focused debates on climate change in India’s Parliament occurred in the build-up to the Copenhagen negotiations and focused heavily on negotiation issues and limiting India’s concessions, rather than addressing climate change through international coordination (Parliamentary Debates 2012).

This section lays out three important perspectives on climate change—civil society, private sector, and labour—that provide a

window to the shifting domestic politics of climate change in India. A fourth chapter analyses an extremely important shaper of public perception, namely, media coverage of climate change. Collectively, these chapters suggest growing engagement with the issue, but the terms of engagement are dominated by relating climate change to existing concerns.

In his review of India's civil society action on climate change, Swarnakar, in Chapter 15, shows how civil society organizations can broadly be defined by one of the two approaches: sustainability focused and relatively apolitical; or climate justice focused and more overtly political. He further notes that the justice perspective has both an outward-facing emphasis on distribution within countries as well as inward-facing focus on distribution questions within India. The climate justice perspective often brings organizations into a complex relationship with national policymaking, as they seek to balance the tension between internal and external critiques. On balance, Swarnakar argues that a coherent climate change movement is yet to fully emerge in India.

In a perspective from business, Venkateswaran and Rajan argue in Chapter 16 that, in a 'triple-bottom line' formulation, Indian business has been paying greater attention to the social and environmental bottom line, in greater balance with a financial bottom line. They observe greater participation in efforts to prepare environmental reporting and governance frameworks, as well as adoption of significant internal actions, such as emission targets and internal carbon markets. They attribute these shifts, in part, to greater pressures from investors, customers, employees, and communities. At the same time, these changes are limited to larger, global companies; and the micro, small, and medium enterprises are less engaged with this agenda. This chapter, however, represents one snapshot and one perspective among the large and complex business community. Other efforts at reviewing business at large find similar trends, but the sample size remains small. A more systematic review is yet to be written, that takes into account the full range of actors. With this substantial caveat, the emergence of at least some voices within Indian business that are seriously engaging climate change is worthy of note.

In Chapter 17, Roy, Kuruvilla, and Bhardwaj, outline the thought process within another significant and politically important

community, labour. They explain the concept of a ‘just transition’ that recognizes the need for an energy transition, but also assert the need that social goals must be simultaneously met. In India, an important objective of doing so must include the retraining of labour in the coal industry and rehabilitation of coal-mining areas. Furthermore, climate change will impact the health of vulnerable workers and their households, indicating that a just transition will also involve improving access to social services in workplaces, streets, and homes. This chapter demonstrates the complexity of the task facing India, as the country attempts to address development challenges, provide energy for development, address climate change, and maintain a commitment to social inclusion.

Chapter 18 by Jogesh provides a rare analysis of Indian print media from several newspapers and across seven years. Several interesting themes emerge from this analysis. For example, stories of scepticism on climate science are noteworthy by their relative absence and articles on climate impact are also more prominent. However, mitigation issues continue to receive more widespread coverage than adaptation issues. In a validation of the observation that there has been an uptick in domestic action, media coverage of domestic policy rivals that of international negotiations.

These four chapters provide only a snapshot of how key constituencies are engaging climate change in India. While attention to the issue is growing and explicit consideration of it among groups such as business and labour is increasingly apparent, it would be overstating the case to suggest that climate change is a mainstream political issue or is likely to be one soon. However, it is increasingly part of the broad slew of issues considered when various interest groups assess their strategies.

Policies

The previous discussion suggests that, in the years since 2009, various developments have set the stage for an active debate around Indian policymaking on climate change. The international process has shifted to emphasize ‘bottom-up’ domestic actions, a vibrant domestic civil society sector has emerged to engage with climate policy, and media coverage illustrates a steep rise in coverage of

domestic policy. To what extent and how has this shifting context resulted in the broadening and deepening of climate policymaking at various scales? This section examines this question across national and sub-national scales, with a focus on not only policy but also climate institutions. In addition, some aspects of climate policy as they pertain to specific sectors are also covered in the next section on climate and development.

Dubash and Ghosh, in Chapter 19, set the stage by reviewing the emergence of national policies, and also national institutions. This discussion starts with the National Action Plan on Climate Change (NAPCC) and its various missions, extensions of these often driven by the pursuit of 'co-benefits' that bring both climate and development gains, and the formulation of India's NDC for the Paris Agreement. Significantly, the chapter also covers the spread of climate institutions, which while weak and in their early stages, provide the spaces within which climate discussion is likely to be mainstreamed, if at all, in the coming years.

Significantly, climate policymaking has expanded to the state level, as discussed in the next two chapters. In Chapter 20, Dubash and Jogesh describe the process of formulating state action plans, identifying significant shapers of these plans, such as high-level political support, the process through which the plan is created, and its institutional home. They find that plans have been 'door-openers' for more discussions about sustainability, but, as of the time of writing in 2014, they had not fully provided a platform for mainstreaming climate change, nor had they added the necessary institutional capacity to do so in the future. Chapter 21 by Gogoi provides a more complementary recent update to the state plan process, from the perspective of a consultant engaged in assisting states. She discusses how in their further evolution beyond initial formulation, these plans have become vehicles for integrating climate change risks and opportunities into development policies, or 'mainstreaming'. She finds that there are limited examples of state plans serving to reorient the work of line departments, but the plans have provided a structure that helps shape new donor-funded programmes. The chapter then examines various governance challenges to mainstreaming, including political ownership and extent of convergence with existing development agendas. In

addition to national and state policy development, many cities are exploring climate policies, which are discussed further in the chapter on urban India in the next section.

The policy section ends with two cross-cutting enablers of climate policy: finance and technology. Both have long been central elements of India's negotiating position, on the grounds that India needs to have adequate support in terms of finance and technology in order to take climate action. While touching on India's international stance, these chapters focus substantially more on understanding these issues in India's climate policy context. Mandal, in Chapter 22, begins by explaining some conceptual confusions that can obscure India's approach to climate finance. Although India has been firm that climate finance should be 'additional' to development finance, this boundary is far more blurred in terms of its own domestic climate finance. He goes on to examine important institutional questions: how is India organized internally to mobilize domestic and international climate finance, identify uses for it, and ensure its full deployment? As much as availability of finance, these issues could limit the effectiveness of climate finance in India.

In Chapter 23, Sagar starts by reviewing technology in the UNFCCC process, but quickly moves on to explain how, in practice, understanding the implementation of technological change in the climate arena requires attention to a variety of scales, from the firm up to the larger ecosystem of actors—research institutions, government agencies, consultancies—and the institutions within which they are embedded. He then discusses examples of how technology adoption plays out in India's energy sector, with a few successes in deployment. He leaves the reader with an important question: what are the elements of a strategic approach to technology innovation, beyond deployment alone, required to fully meet India's needs in climate change-related technology?

These chapters suggest that the discussion has moved on from whether India should develop domestic climate policies, to the content and form of those policies. While their cogency and effectiveness is undoubtedly a work in progress, policies have also been accompanied by institutional construction, which has left lasting sites for their further refinement.

Climate and Development

The discussion on climate policies and institutions suggests that there is no overarching national institution for climate policymaking, nor indeed do such institutions exist in states. This is of a piece with most global experience, where the main challenge for climate change is to stimulate internalization of climate change considerations in various line ministries and departments (Somanathan et al. 2014). Doing so is as much a conceptual as an institutional challenge. It requires bringing climate concerns into conversation with a host of existing objectives that command the attention of line departments. Climate change then enters this conversation as one among multiple stressors, and both mitigation and adaptation as important additions to multiple existing objectives (Bhardwaj et al. 2019; Khosla et al. 2015; Lele et al. 2018). To be tractable, a policy conversation thus framed has to occur on a sector-by-sector basis; both stressors and objectives will vary by sector. Laying out and beginning this conversation is the task of this section, which examines integration in terms of the implications of climate for development and vice versa, and the efforts to internalize these linkages in policymaking across issues of mitigation and adaptation in key sectors.

The future of the energy sector is most directly, and closely, tied to climate mitigation. Sreenivas and Gambhir, in Chapter 24, starkly paint India's dilemma in this sector: should India focus on the short-term immediate challenges of energy poverty, access, and reliability, or should it also consider the longer-term challenges of avoiding lock-in in the face of a rapidly changing sector? They suggest the answer lies in simultaneously considering multiple objectives, and apply this approach through a tour of energy demand and supply sectors. They highlight key challenges facing the sector, such as deepening the adoption of energy efficiency, electrifying transportation, and managing the shift from coal to renewable energy which could disrupt electricity. One of the important lessons they draw is that if India is to meet its social and economic needs even while turning to a lower carbon trajectory, the process of policymaking needs to be more deliberate and transparent in order to address governance challenges that have held back the sector in the past.

Khosla and Bhardwaj, in Chapter 25, draw our attention to an ongoing transformation that is likely to shape Indian society and economy, as well as its energy future: urbanization. The energy needs to meet the shift to urban lifestyles of an estimated 400 million new urban citizens are immense, but this shift also provides an opening to build both low-carbon and climate-resilient cities. They document the upsurge of efforts to integrate climate adaptation and mitigation into India's urbanization, driven both by government and by non-state networks and alliances, including international partners. They particularly highlight the need for attention to large-term structural patterns that would lock-in India's cities to energy consumption paths, a focus on multiple objective-based approaches given India's pressing development needs, and the institutionalization of decision making that enables fluid coordination across sectors and objectives, rather than silo-based decisions.

Indian forests are important to climate mitigation, as a source of carbon sinks, but climate change can also affect forests both directly, through impacts, and indirectly, through efforts at mitigation that have secondary impacts on India's forests. Lele and Krishnaswamy, in Chapter 26, explain that climate change adds a controversial objective to an already confusing governance context where forests are expected to be simultaneously repositories of biodiversity, provide ecosystem services, produce timber, and enable livelihoods through use of non-timber forest products. Following through on India's forest-related pledge as part of the Paris Agreement adds further challenges to what is already tortuous terrain and presents substantial governance challenges. These challenges are exacerbated by confused and contested data on the sequestration potential of India's forests.

The three chapters that follow deal with significant adaptation challenges in various fields: from the water sector to agriculture and to coastal zones. The impacts of climate change are often cited as among the most worrisome consequences for South Asia. The realities of science, data, and policy formulation, however, as Srinivasan shows in Chapter 27, suggest that translating this concern into an agenda of action is fraught with challenges. While climate change is expected to lead to water stress, multiple other stressors such as land-use change, groundwater abstraction, and urbanization, to

name a few, may dominate in the short run. Moreover, as with forests, urbanization, and energy, the water sector also has to be managed for multiple objectives, including the short-term objectives of adequate supply, quality, and reliability. Srinivasan suggests that operationalizing these multiple-stressors, multiple-objectives approach, requires mainstreaming into multiple scales of climate planning, a challenge which water policymaking in India is only just beginning to grapple with.

For a country where a large share of livelihoods is tied to agriculture, the impacts of climate change on this sector are of great concern. In Chapter 28, Kavi Kumar and Viswanathan take the reader through the state of knowledge on impacts of climate change on yields of key crops such as rice and wheat. They then examine the prospects and experience of adaptation strategies in India, such as adoption of new technologies, risk management through insurance, and, in an extreme, migration. To mainstream adaptation, however, requires understanding of how climate change interacts with other stressors to induce harms. Responses, they suggest, can vary from 'climate proofing' existing initiatives to correct for past planning that fails to account for climate impacts, to a 'climate-first' approach that prioritizes climate-resilient strategies, to 'development first' that integrates climate change concerns from the start. The last, in particular, requires institutional structures capable of such integration.

Finally, in Chapter 29, Arthur takes the reader on a careful and vivid tour of the implications of climate change for India's vast coastlines and marine ecosystem. Like the other impact-focused chapters, he starts by reviewing the likely drivers of impacts: rise in sea-level; increased surface sea temperature; ocean current disruption; ocean acidification; and intensity and frequency of weather events. Complicating the story are how these drivers interact with non-climate factors, such as higher pollutant and chemical loads from land run-off, and the fact that ocean responses are likely to be non-linear. He reviews the coastal-specific components of selected state plans to assess how well they account for these complexities, and provides details with a case study of the Lakshadweep. He concludes by outlining strategies for resilience, but also cautions the need for back-up strategies, including, in the extreme, retreat from coastal areas.

Collectively, the chapters in this section illustrate both the conceptual gains as well as the challenges of integrating climate change into a multi-stressor and multiple-objective conceptual framework of development challenges. In some areas, such as energy, there is considerable scope for co-benefits—the joint realization of climate mitigation and development objectives. In others, such as agriculture, coasts, and, with a longer horizon, water, development planning that ignores climate change impacts risks being highly incomplete.

India has had a long and somewhat fraught history of engagement with the climate challenge. For about the first two decades since this discussion formally began with negotiation of a climate treaty, the public discussion in India was limited and focused on *whether* to engage climate change as a challenge, given pressing development concerns and the dominant responsibility of others for causing the problem. Over the last decade, attention has turned to *how* to engage with climate change, and the framing has shifted to one of integrating climate change and development. This shift is due, in part, to the growing recognition of India's vulnerabilities, the awareness that, in some cases, development and climate mitigation may actually complement each other, and the internalization of climate change as a factor in foreign policy and strategic thinking.

Much of this book has focused on the question of how India can fruitfully engage with climate change in the context of India's larger development challenges. While the complexity of the issue requires engagement with the details of each chapter, collectively the chapters offer at least four high-level conclusions.

First, to advance the understanding and internalization of climate change challenges in India requires careful understanding of the linkages between climate change and development outcomes in both mitigation and adaptation realms. The discussion in the chapters presented here suggests that these linkages are best understood on a sector-by-sector basis and are usefully informed by a multi-stressor and multi-objective framework.

Second, a clear understanding of how climate change is relevant to development outcomes can also provide a pathway to more

progressive and supportive politics around climate change. Clear analysis of cases of co-benefits (where climate and development gains go together) can lead to a convergence of support for certain policies. For example, climate change could also be a political force multiplier for certain 'no-regrets' policies, such as energy and water efficiency. In some cases, climate change considerations can bring in new constituencies to long-standing debates, such as around agricultural cropping systems, leading to productive new alliances and conversations. Of course, climate change could also complicate political conversations by highlighting trade-offs rather than finding synergies, but even in such cases a clear understanding that informs a political choice is important. An example might be the shift underway in India away from biomass-based cooking to commercial fuel-based cooking, which brings health and social gains, but likely also carbon costs; a context in which policymakers are correctly likely to prioritize the former. Fortunately, the sector studies here suggest many more instances of alignment between climate change and development outcomes than trade-offs, a finding also reinforced by the global literature (IPCC 2018: Figure SPM 4).

Third, India's first decade of domestic climate policymaking has provided some gains through experimentation, but was hampered by the early state of integrative knowledge and limited institutional capacity. On the plus side of the ledger, the scale of expanded policymaking, from cities to states and at the national level, has started conversations and set in place processes that provide a useful platform for deepening policymaking. To do so requires explicit attention to policies that are designed to attend to multiple and simultaneous objectives (Bhardwaj et al. 2019). Moreover, institutions of climate governance remain embryonic; capacities are limited and the challenge of coordinating and managing incentives across disparate and diverse institutions is considerable. Given the multi-level governance framework of climate change, devising means to have national policies that are informed by global contexts, particularly in the areas of finance and technology, also needs attention.

Finally, for too long India's negotiation policy has placed the cart before the horse; negotiating objectives have shaped domestic policymaking rather than the other way around. The history of India's negotiations suggests a reflexive effort to maintain the issue

at diplomatic arm's length, and indeed modulate domestic policy to enable this diplomatic outcome. This has begun to change, but the reorientation is not complete and, indeed, the chapters here suggest continuing debate on the extent to which it is needed. However, if, as many chapters in this book also suggest, India has interests in an effective global regime due to its vulnerability, and that co-benefits provide a plausible pathway to mitigation policies, then India's negotiation strategy should be directed by a clear-headed understanding of how those domestic interests should be reflected at the international level. This clarity also provides an opportunity to play a larger role in shaping the global debate in a post-Paris scenario, marked by the fluid geopolitical context of a retreating US and an advancing China. This said, the debate continues apace within India on an appropriate negotiation strategy, the continued role of equity as a driving consideration, and to what extent India's interests were met in the Paris Agreement, as illustrated by the chapters in this volume. Going forward, the salient question is: can a climate-vulnerable India, empowered by knowledge on how climate change policy and development outcomes can be made to work together, actively advance its interests in a fluid international arena, rather than assuming its interests lie in insulating itself from the international regime?

Taken together, these four points suggest that Indians and India are getting better at talking about, understanding, and acting on the challenge of bringing together climate change and development. It is in the nature of 'wicked' problems that these understandings are continually contested and reformulated, and the discussion on advancing climate policy in India is no exception. Nonetheless, a road has been laid towards productive engagement on the interaction between climate change and development. It is now up to various sections of Indian society—policymakers, academics, media, business, and civil society, among others—to walk this path towards enhanced debate and improved action.

References

- Atteridge, Aaron, Manish Kumar Shrivastava, Neha Pahuja, and Himani Upadhyay. 2012. 'Climate Policy in India: What Shapes International, National and State Policy?', *Ambio*, 41(1): 68–77.

- Bhardwaj, Ankit, Madhura Joshi, Radhika Khosla, and Navroz K. Dubash. 2019. 'More Priorities, More Problems? Decision-Making with Multiple Energy, Development and Climate Objectives', *Energy Research & Social Science*, 49(March): 143–57. Available at <https://doi.org/10.1016/j.erss.2018.11.003>.
- Bidwai, Praful. 2010. 'An India That Can Say Yes: A Climate-Responsible Development Agenda for Copenhagen and Beyond—Climate & Resources', Heinrich Böll Stiftung India. Available at <https://in.boell.org/2010/03/01/india-can-say-yes-climate-responsible-development-agenda-copenhagen-and-beyond-climate>; accessed on 6 May 2019.
- . 2012. 'The Politics of Climate Change and the Global Crisis', Transnational Institute, 12 January. Available at <https://www.tni.org/en/publication/the-politics-of-climate-change-and-the-global-crisis>; accessed on 6 May 2019.
- CAIT Climate Data Explorer. 2018. Available at <https://cait.wri.org/historical>; accessed on 17 January 2019.
- Chattopadhyay, Sulagna. 2014. *Climate Change in India: Views on the Concerns of Adaptation and Survival in a Fast Changing World*. New Delhi: Iris Publications Ltd.
- Dubash, Navroz K. 2012a. 'Climate Politics in India: Three Narratives', in Navroz K. Dubash (ed.), *Handbook of Climate Change and India: Development, Politics and Governance*, pp. 197–207. New Delhi: Oxford University Press.
- (ed.). 2012b. *Handbook of Climate Change and India: Development, Politics and Governance*. Routledge.
- . 2013. 'The Politics of Climate Change in India: Narratives of Equity and Cobenefits', *WIREs Wiley Interdisciplinary Reviews: Climate Change*, 4(3): 191–201. Available at <https://doi.org/10.1002/wcc.210>.
- . 2017. 'Safeguarding Development and Limiting Vulnerability: India's Stakes in the Paris Agreement', *Wiley Interdisciplinary Reviews: Climate Change* 8 (2): e444. Available at <https://doi.org/10.1002/wcc.444>.
- Dubash, Navroz K., Radhika Khosla, Ulka Kelkar, and Sharachandra Lele. 2018. 'India and Climate Change: Evolving Ideas and Increasing Policy Engagement', *Annual Review of Environment and Resources*, 43(1): 395–424.
- Dutta, Soumya. 2013. *Climate Change and India: Analysis of Political Economy and Impact*. New Delhi: Daanish Books; South Asia: Rosa Luxemburg Stiftung.
- Hulme, Mike. 2009. *Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity*. Cambridge: Cambridge University Press.

- Iacobuta, Gabriela, Navroz K. Dubash, Prabhat Upadhyay, Mekdelawit Deribe, and Niklas Hohne. 2018. 'National Climate Change Mitigation Legislation, Strategy and Targets: A Global Update', *Climate Policy*, 18(9): 1114–32.
- Intergovernmental Panel on Climate Change (IPCC). 2018. *Global Warming of 1.5°C*. An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Geneva: IPCC, World Meteorological Organization. Available at <https://www.ipcc.ch/sr15/>; accessed on 6 May 2019.
- Jordan, Andrew, Dave Huitema, Harro van Asselt, and Johanna Forster. 2018. *Governing Climate Change*. Cambridge: Cambridge University Press.
- Keohane, Robert O. and David G. Victor. 2011. 'The Regime Complex for Climate Change'. *Perspectives on Politics*, 1: 7–23.
- Khosla, Radhika, Srihari Dukkupati, Navroz K. Dubash, Ashok Sreenivas, and Brett Cohen. 2015. 'Towards Methodologies for Multiple Objective-Based Energy and Climate Policy', *Economic & Political Weekly*, 50(49): 49–59.
- Lele, Sharachchandra, Veena Srinivasan, Bejoy K. Thomas, and Priyanka Jamwal. 2018. 'Adapting to Climate Change in Rapidly Urbanizing River Basins: Insights from a Multiple-concerns, Multiple-stressors, and Multi-level Approach', *Water International*. Available at <https://doi.org/10.1080/02508060.2017.1416442>.
- Michaelowa, Katharina and Axel Michaelowa. 2012. 'India as an Emerging Power in International Climate Negotiations', *Climate Policy*, 12(5): 575–90. Available at <https://doi.org/10.1080/14693062.2012.691226>.
- Narain, Sunita. 2015. 'Paris—The Endgame for Climate Justice', *Business Standard*, 20 December. Available at https://www.business-standard.com/article/opinion/sunita-narain-paris-the-endgame-for-climate-justice-115122000640_1.html; accessed on 6 May 2019.
- Ostrom, Elinor. 2010. 'Polycentric Systems for Coping with Collective Action and Global Environmental Change', *Global Environmental Change*, 20(4): 550–7. Available at <https://doi.org/10.1016/j.gloenvcha.2010.07.004>.
- Parliamentary Debates. 2012. 'Climate Change and Parliament', in Navroz K. Dubash (ed.), *Handbook of Climate Change and India: Development, Politics and Governance*, pp. 230–45. New Delhi: Oxford University Press.
- Rajamani, Lavanya. 2012. 'The Reach and Limits of the Principle of Common but Differentiated Responsibilities and Respective Capabilities in the Climate Change Regime', in Navroz K. Dubash (ed.), *Handbook of Climate*

- Change and India: Development, Politics and Governance*, pp. 118–29. New Delhi: Oxford University Press. Available at <http://www.cprindia.org/research/chapters/reach-and-limits-principle-common-differentiated-responsibilities-and-respective>; accessed on 6 May 2019.
- Saran, Samir and Aled Jones. 2016. *India's Climate Change Identity: Between Reality and Perception*. Cham, Switzerland: Palgrave Macmillan.
- Sengupta, Sandeep. 2012. 'International Climate Negotiations and India's Role', in Navroz K. Dubash (ed.), *Handbook of Climate Change and India: Development, Politics and Governance*, pp. 101–17. New Delhi: Oxford University Press.
- Sethi, Surya. 2015. 'The Ultimate Cirque Du Soleil', *The Hindu Business Line*, 22 December. Available at <https://www.thehindubusinessline.com/opinion/the-ultimate-cirque-du-soleil/article8018665.ece>; accessed on 6 May 2019.
- Shukla, P.R., A. Garg, and Hem H. Dholakia. 2015. *Energy-Emissions Trends and Policy Landscape for India*. New Delhi: Allied Publishers.
- Somanathan, Eswaran, Thomas Sterner, Taishi Sugiyama, Donald Chimanikire, Navroz K. Dubash, Joseph Kow Essandoh-Yeddu, Solomon Fifita, Lawrence Goulder, Adam Jaffe, and Xavier Labandeira. 2014. 'National and Sub-National Policies and Institutions'. In *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, et al. (eds), pp. 1141–205. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Steffen, Will, Johan Rockström, Katherine Richardson, Timothy M. Lenton, Carl Folke, Diana Liverman, Colin P. Summerhayes et al. 2018. 'Trajectories of the Earth System in the Anthropocene', *Proceedings of the National Academy of Sciences*, 115(33): 8252–9. Available at <https://doi.org/10.1073/pnas.1810141115>.
- Vihma, A. 2011. 'India and the Global Climate Governance: Between Principles and Pragmatism', *The Journal of Environment & Development*, 20(1): 69–94. Available at <https://doi.org/10.1177/1070496510394325>.

SECTION I

CLIMATE CHANGE IMPACTS

Impact of Climate Change on India

J. Srinivasan

What tools are available to study climate change? What evidence is available to understand changes in Indian climate during the twentieth century? What do climate models predict regarding likely changes due to climate change in the twenty-first century? This chapter will provide a brief introduction to understanding the science of climate change in India and its impacts, organized around the aforementioned questions. While this is a complex topic, the aim here is to provide a baseline level of knowledge from which to engage and understand climate policy debates in India.

The Tools of Climate Science

Do we really understand the factors that control global and Indian climate? We know that the earth would have been more than 30°C colder if minor gases like carbon dioxide (CO₂), methane, ozone, and water vapour were absent (Mitchell 1989). Although the amount of these gases in the earth's atmosphere is very small, they have a huge impact on earth's climate because of their ability

to absorb radiation emitted by the earth's surface (like the glass in a greenhouse).

The global mean temperature is calculated based on thousands of thermometers on land and measurements by ships over the ocean. They show that the global mean temperature has increased by around 0.85°C during the period 1880–2012 (Intergovernmental Panel on Climate Change [IPCC] 2013). This increase has been shown to be primarily on account of the increase in CO_2 and other greenhouse gases (GHGs) in the atmosphere, and this was proven by running climate models with and without the increase in all GHGs for 120 years. The climate models use all the laws of physics and the number-crunching capability of modern computers. The increase in global mean temperature predicted by these models agrees with observations by thermometers, validating the use of these models to understand the effects of CO_2 emissions on the trajectory of global mean temperature (Hegerl et al. 2007).

The amount of CO_2 in the earth's atmosphere has increased by more than 40 per cent during the past 150 years, on account of burning of fossil fuels (coal, oil, and natural gas), deforestation, and other land use changes (Hartmann et al. 2013). This increased CO_2 not only has direct effects on climate change but also has indirect effects, or so-called positive (accelerating warming) and negative (decelerating warming) feedbacks. In an example of a positive feedback, an increase in global mean temperature caused by a rise in CO_2 levels in turn leads to increase in water vapour, which then causes more thermal radiation emitted by earth to be trapped. Another factor that can cause positive feedback is the melting of ice in the polar region, and in the Himalayas, due to higher average temperatures; ice reflects most of the sun's radiation, while water absorbs most of the sun's radiation, further amplifying warming.

During the Ice Ages, which have occurred many times in the past, CO_2 and methane levels in the earth's atmosphere were much lower than the present. We know this based on measurements of the composition of the air trapped in the ice samples obtained from Arctic, Antarctic, and Himalayas, which allow an analysis of the air composition and temperature record going back 400,000 years. The amount of CO_2 in the air trapped in these ice samples varied between 180 parts per million and 280 parts per million (Jansen et al. 2007:

Figure 6.4). In contrast, in the early years of the twenty-first century, the concentration of CO_2 had crossed 400 parts per million. When combined with the evidence from models of the effect of CO_2 on global average temperatures, this steep increase provides grounds for concern.

In addition to changes induced by human beings, there are also natural factors, such as volcanic eruption and variation in the sun's energy incident on earth, that can cause changes in the earth's climate. However, based on the evidence from the techniques described earlier, in the twenty-first century, the changes induced by human beings will have a much greater impact on earth's climate than natural causes.

In addition, there are also impacts caused by regionally specific factors, such as change in land use and particulates (like sulphates and soot). As we describe later, these factors also complicate the understanding of global climate change since they may exacerbate or dampen these effects. Hence, it is not easy to attribute regional climate change to a single factor such as the monotonic increase in CO_2 .

The IPCC was created by the United Nations (UN) to enable scientists from all parts of the world—using techniques such as those described earlier—to provide an authentic summary of our present understanding of the climate change induced by human beings and indicate the ways to mitigate this climate change or adapt to it (IPCC n.d.). The reports published by the IPCC between 1990 and 2013 have provided the scientific basis for the range of historic agreements between countries on addressing climate change, including the one concluded in Paris in December 2015 to reduce CO_2 released by human activities.

Projected Climate Change in the Twenty-First Century

What are the observed changes in climate variables from the twentieth century till date, both globally and in India? While climate change is expected to accelerate based on existing trends, some evidence already exists from data on temperature, rainfall, and glaciers, the three important ways in which climate change is likely to manifest.

Temperature

Presently, the rate of increase in global mean temperature is much faster than the changes in the global mean temperature that have occurred in the past on account of natural climate variations. When the earth emerged from the last Ice Age, about 20,000 years ago, the global mean temperature increased at the rate of 1°C in 1,000 years (Jansen et al. 2007). However, the global mean temperature has increased by around the same amount, that is, 1°C , in the last 120 years alone, with a large increase occurring during the last 40 years of the twentieth century, a rate about *ten times* faster than that driven by natural climate variation alone (Smith and Reynolds 2005). Hence, we need to be concerned that natural ecosystems may not be able to adjust to the rapid changes in temperature witnessed in the twentieth century.

The simulations by complex climate models have shown that this increase in temperature, as mentioned earlier, is primarily on account of a 40 per cent increase in CO_2 in the atmosphere during the past 150 years (Hartmann et al. 2013). The amount of CO_2 in the earth's atmosphere has increased by 120 parts per million in the last 150 years. Indeed, the rate of increase of CO_2 seen in the twentieth century has been *hundred times* faster than the rate of increase observed in the past due to natural climate changes, especially in comparison to what was observed when the earth emerged from the last Ice Age. Hence, we can conclude that such a large increase in CO_2 could not have occurred on account of natural causes alone.

In India, we have excellent observations recorded by the India Meteorological Department, based on more than 1,000 stations, for the past 120 years. These stations contain thermometer, rain gauge, and instruments to measure winds and relative humidity. Based on these records, the all-India annual mean surface air temperature has increased by 0.6°C during the period 1901–2010 (Rajeevan and Nayak 2017). Most of the increase was seen during the past 30 years during the pre-monsoon season and in winter. The change in mean temperature has been primarily on account of a long-term trend of an increase in daily maximum temperature. There is only a short-term, 30-year trend of increase in daily minimum temperatures, but the reasons for this variation in minimum

temperatures are not well understood. In contrast, the increase in global mean temperature is primarily on account of an increase in daily minimum temperature. The sea surface temperatures in the oceans around India have also risen by 0.6°C during the past 50 years, with the largest increase seen around the equatorial Indian Ocean (Rajeevan and Nayak 2017).

In addition, the number of heatwaves during the pre-monsoon period has shown an increasing trend. During the period 1970–2005, the number of hot days—defined as days with maximum temperature in the top 10 percentile—increased from 2 days to 20 days in the west coast of India (Kothwale, Revadekar, and Rupa Kumar 2010). The number of cold days decreased by 10 days during the same period. In some high-altitude stations in Nepal, the surface air temperature has increased by 1°C per decade during the last 30 years of the twentieth century (Shrestha et al. 1999). This is much larger than that observed in most stations in India. In summary, the temperature records show that temperature has increased in most parts of India in the last 100 years.

Rainfall

The trends in rainfall are less clear as compared to temperature, both because of confounding factors and because of changes in the distribution of rainfall across a year. Most of the rainfall in India occurs during the summer monsoon (June–September). The all-India summer monsoon rainfall has not shown any large trend during the last 140 years, for the most part falling within 10 per cent of the long-term mean. However, at the regional level, some trends are visible. Chhattisgarh has shown a significant decline in rainfall, the cause of which is unknown. Kerala too has shown a declining trend in rainfall for the past 50 years and some climate models indicate that this is related to global warming (Rajeevan and Nayak 2017; Rajendran and Kitoh 2008).

However, there are other confounding factors that affect these trends. The Indian summer monsoon rainfall can be much lower (or higher) than normal during El Niño (La Niña) years, when the sea surface temperatures in the equatorial Pacific Ocean are warmer (or cooler) than normal. The Indian rainfall can be above (or below)

normal if the sea surface temperatures in the western equatorial Indian Ocean are above (or below) normal. The changes in the sea surface temperatures in the tropical oceans thus exert a strong influence on the Indian summer monsoon.

In addition, small solid particles suspended in the atmosphere, called aerosols, can also influence the Indian summer monsoon rainfall. The emission from thermal power plants (that burn coal or oil) can lead to large emissions of sulphur dioxide, which later become sulphate aerosols. The sulphate aerosols cool the earth's surface and the atmosphere, and hence can lead to a decrease in Indian summer monsoon rainfall. On the other hand, soot emitted from incomplete combustion (diesel engine exhaust or burning of firewood for cooking) heats the atmosphere and cools the surface. The impact of soot on Indian summer monsoon rainfall can be complex, and hence it is not certain if the presence of soot will lead to an increase or decrease of monsoon rainfall. Natural aerosols such as dust can also influence rainfall during the pre-monsoon season. At present, we do not have sufficient understanding of the impact of aerosols such as dust or soot on monsoon rainfall.

As mentioned earlier, the annual average all-India rainfall does not show significant trends, although there are regional trends. In addition, there has been a shift in the distribution of rainfall towards more extreme rainfall events. According to Goswami et al. (2006), heavy rainfall events (rainfall greater than 100 millimetre [mm]/day) have increased by 50 per cent in Central India in the past 50 years. This rapid increase in heavy rainfall events may be on account of global warming or increase in aerosols. The seasonal mean all-India monsoon rainfall does not show any long-term trend because the increase in extreme rainfall events has been compensated by a decrease in moderate rainfall events (rainfall below 100 mm/day). The number of cyclonic disturbances has decreased from seven per year in the mid-twentieth century to below two per year in the last decade of the twentieth century (Dash et al. 2007). In addition, there has been a decrease in winter snowfall in Western Himalayas in the period 1990–2010. Finally, the annual mean relative humidity, averaged over 244 stations in India, has increased from 63 per cent to 66 per cent during the period 1968–2008 (Rajeevan and Nayak 2017). These changes indicate that extreme rainfall events have

definitely increased, while moderate rainfall events have decreased in the past 50 years. These trends have increased both floods and droughts in India.

Glaciers

There is a lot of concern about the impact of global warming on glaciers, which could reduce the water stored in the glaciers, and hence the world's freshwater supplies, including in India, as well as exacerbate sea-level rise. In most parts of the world, glaciers are retreating; quite rapidly in some parts (more than 20 metres per year) and more slowly in others. Our knowledge about glacier retreat is limited because less than 0.2 per cent of the glaciers on earth are monitored regularly (Bolch et al. 2012).

Climate change can affect glacier retreat in a number of ways. A glacier can retreat rapidly on account of warmer air above it and less snow falling on it. In addition to the change in temperature and snowfall, the rate of retreat of the glacier also depends upon the altitude of glacier. For example, at many high-altitude stations, the air temperatures have increased more rapidly than in stations at lower altitudes, thereby leading to high melt rates at higher altitudes.

In the Indian Himalayas, small glaciers (area less than 1 sq. km) have been retreating rapidly. In the Chenab basin in Himachal Pradesh, the area of small glaciers has decreased by 38 per cent during the period 1962–2004, while the area of large glaciers (greater than 10 sq. km) has decreased by 12 per cent in the same period (Kulkarni et al. 2007). Hence, many small glaciers in the Himalayas may disappear completely in the next 50 years.

Sea-Level

A rise in sea-level threatens coastal and deltaic areas, which house a large share of the world's population, and also exacerbates the effects of storm surges. Sea-level rise is caused by an increase in sea surface temperature that will lead to expansion of sea water, as well as by ice melting from land glaciers. The global sea-level has increased by around 190 mm from 1901 to 2010 (Church and White 2011;

IPCC 2013). The rate of sea-level rise was 1 mm/year in the early twentieth century and 3.3 mm/year during the last decades of the twentieth century (Church and White 2011). However, as with rainfall, sea-level rise is affected by local factors, such as subsidence, as much as by global factors. For example, in Mumbai, sea-level has increased by 0.77 mm/year during the past 100 years, while in Kolkata the sea-level has increased by 5.22 mm/year during the past 50 years (Unnikrishnan and Shankar 2007).

Sea-level rise is a major concern since most of the human population resides within 50 km of the sea coast. In India, the coastal states, such as West Bengal and Gujarat, are the ones most vulnerable to sea-level rise. The increase in sea-level will cause enhanced damage during storm surges that occur during cyclone landfall.

Interaction between Air Quality and Climate Change

In India the combination of declining air quality and climate change will pose new challenges. There has been a dramatic decline in air quality—defined by the presence of particulates and gases such as sulphur dioxide and oxides of nitrogen—in India during the last three decades. Air quality has significant, direct health impacts. Thus, the Lancet Commission on pollution and health has warned that air pollution is the largest environmental cause of disease and death in the world today (Watts et al. 2015). The Commission estimates that 9 million premature deaths in the world every year can be attributed to air pollution.

The increase in air pollutants affects climate outcomes through a variety of pathways. For example, these pollutants increase the amount of ozone at the ground level, which damages our lungs and the growth of plants. (By contrast, ozone in the stratosphere protects us from harmful ultraviolet radiation, which is why the ‘ozone hole’ over Antarctica was dangerous.) Particulates, or aerosols, reduce the solar radiation reaching the earth and hence cool the surface of the earth, which can lead to weakening of the Indian monsoon. Moreover, particulates in the atmosphere alter the life cycle of clouds. By altering the size distribution of droplets in clouds, they can lead to more heavy rainfall events, and also increase the duration of dry spells during the monsoon. The total

cloud cover during the monsoon has declined from 72 per cent to 66 per cent during the past 50 years and the percentage of area under drought in India has increased from around 10 per cent to 20 per cent during the period 1959–2009 (Rajeevan and Nayak 2017).

Climate Change in the Twenty-First Century

To predict future climate change in India in the twenty-first century, we need to use climate models. All models indicate that the surface air temperature over India will increase, but the magnitude of the increase varies between 2°C and 4°C (by the end of the twenty-first century). Takahashi, Honda, and Emori (2007) have indicated that an increase in temperature will cause a large increase in mortality due to heatwaves in Asia. Most models also predict an increase in monsoon rainfall in the twenty-first century. However, because these models differ greatly in their ability to simulate and reproduce past patterns of summer monsoon precipitation over India in the twentieth century and match these to rainfall records, the rainfall predictions of these models for India must be used with great caution.

In order to inform adaptation policy, there is a great demand for predicting the effects of climate change at the district level; however, the techniques to accomplish this are, as yet, a work in progress. One approach is to use statistical downscaling of coarse resolution models, but this is not a reliable approach. Shashikanth et al. (2014) have shown that the key uncertainty in statistical downscaling is due to the uncertainty in local circulation pattern simulated by the parent models.

By contrast, the district-scale results obtained from high-resolution models (spatial resolution around 25 km) have more credibility. Rajendran and Kitoh (2008) have shown that a high-resolution climate model simulates the spatial structure of Indian monsoon rainfall very well. This model predicts that Indian monsoon rainfall will increase in most regions of India in the twenty-first century, on account of the increase in CO₂, but there will be a decrease in rainfall over Kerala (see Figure 2.1 [between pages 326 and 327]). This prediction is credible as it has been observed that during the past 50 years,

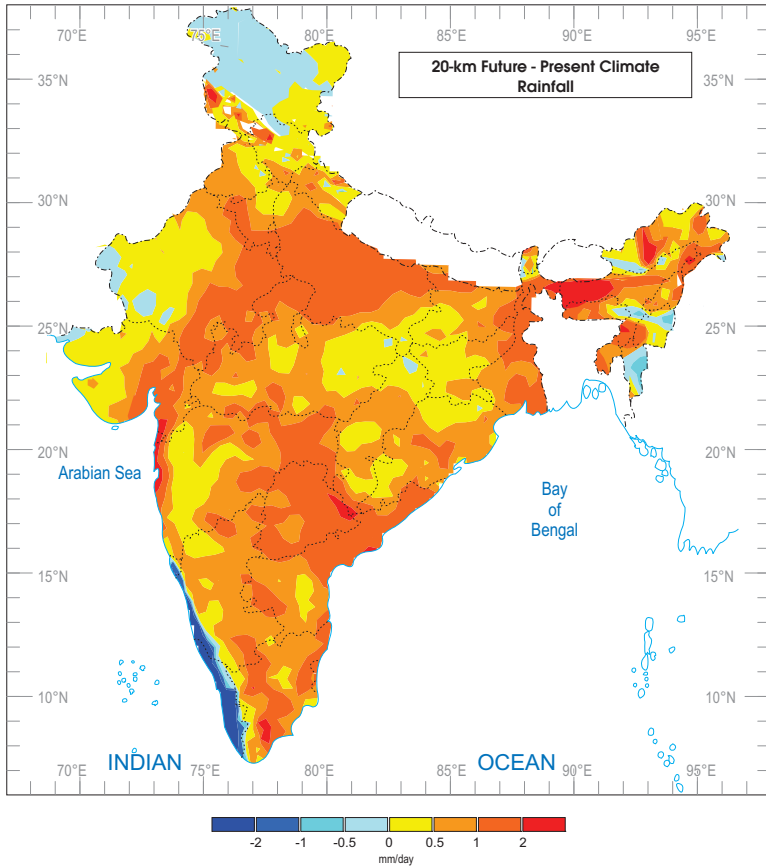


Figure 2.1 Change in Summer Monsoon Rainfall between Future and Present Climate Based on a High Resolution Coupled Ocean-Atmosphere Climate Model

Note: This map does not represent the authentic international boundaries of India. It is not to scale and is provided for illustrative purposes only.

Source: Rajendran and Kitoh (2008). Figure adapted with permission from the Current Science Association.

there has been a decrease in rainfall over Kerala. Thus, we may be witnessing the impact of global warming already. At the same time, Bollasina and Nigam (2009) suggest that current models cannot, as yet, provide durable insights on regional climate feedbacks, nor credible projections of regional hydroclimate variability, suggesting the need for continued caution in how these models are used and their further development.

The impact of increase in temperature on agriculture has been discussed by many investigators. While an increase in rainfall and CO₂ may be beneficial for crops, it does not completely offset the adverse impact of increase in temperature. Panda (2009) and Aggarwal (2003) have estimated a 2–5 per cent decrease in yield potential of wheat and maize for a temperature rise of 0.5–1.5°C in India. Moreover, the impact of air pollution on the yield of crops is likely to be greater than the impact of increase in temperature. In a study in Punjab, Sinha et al. (2015) have shown that the yield of crops can decline by as much as 50 per cent when the ground-level ozone is very high. The evidence for other areas of economic productivity is less well known. For example, the impact of climate change on fisheries is complex since it depends upon changes in ocean temperature, ocean circulation, and oxygen content, and hence no reliable predictions are available.

The increase in surface temperature and changes in rainfall patterns may have an impact on vector-borne diseases. The increase in surface temperature over land, in theory, will make more areas conducive for the spread of malaria and dengue (Bhattacharya et al. 2006). While there has indeed been a large increase in malaria and dengue in India during the past 40 years, we do not have sufficient evidence to demonstrate, as yet, that this increase is linked in any way to global warming. Reiter (2001: 158) has stated that: 'The natural history of mosquito-borne diseases is complex, and the interplay of climate, ecology, vector biology, and many other factors defies simplistic analysis. The recent resurgence of many of these diseases is a major cause for concern, but it is facile to attribute this resurgence to climate change.' However, the interplay between changes in climatic variables such as temperature and rainfall on the one hand, and potential consequences on economic and social

effects such as agricultural yields, fisheries, and health impacts on the other, continue to be an area of concern and active research, with implications for India.

There is clear evidence to show climate change in India in the twentieth century, and this change will accelerate in the twenty-first century. One can expect more extreme rainfall, longer dry spells, higher sea-level, and more severe heatwaves in the future. In India, climate change will have more adverse impact as compared to many other countries. This is because India has a higher population density, larger spatial and temporal variability of rainfall, and more poor people who are vulnerable to climate variability. The climate models used to predict the climate change in the twenty-first century are not able to predict accurately the changes in regional climate. This is caused both by poor spatial resolution of the climate models and our incomplete understanding of the impact of aerosols, clouds, and land-use change on local climate. Adaptation policy has to operate with this imperfect understanding, even as we seek to improve our understanding of the science.

To tackle climate change, we need to take action both at the local and global level. At the global level, we need to ensure that the CO₂ released by human activities is reduced dramatically in the next 50 years. At the local level, we need to reduce air pollution, water pollution, and soil degradation as quickly as possible. This will demand innovations, new technologies, and new approaches to economic development.

References

- Aggarwal, P.K. 2003. 'Impact of Climate Change on Indian Agriculture', *Journal of Plant Biology*, 30: 189–98.
- Bhattacharya, S., C. Sharma, R.C. Dhiman, and A.P. Mitra. 2006. 'Climate Change and Malaria in India', *Current Science*, 90(3): 369–75.
- Bolch, Tobias, Anil Kulkarni, Andreas Käb, Christian Huggel, Frank Paul, J.G. Cogley, Holger Frey et al. 2012. 'The State and Fate of Himalayan Glaciers', *Science*, 336(6079): 310–14.

- Bollasina, Massimo and Sumant Nigam. 2009. 'Indian Ocean SST, Evaporation, and Precipitation during the South Asian Summer Monsoon in IPCC-AR4 Coupled Simulations', *Climate Dynamics*, 33(7–8): 1017–32.
- Church, John A. and Neil J. White. 2011. 'Sea-Level Rise from the Late 19th to the Early 21st Century', *Surveys in Geophysics*, 32(4–5): 585–602.
- Dash, S.K., R.K. Jenamani, S.R. Kalsi, and S.K. Panda. 2007. 'Some Evidence of Climate Change in Twentieth-Century India', *Climatic Change*, 85(3–4): 299–321.
- Goswami, B.N., V. Venugopal, D. Sengupta, M.S. Madhusoodanan, and Prince K. Xavier. 2006. 'Increasing Trend of Extreme Rain Events over India in a Warming Environment', *Science*, 314(5804): 1442–45. Available at <https://doi.org/10.1126/science.1132027>; accessed on 5 May 2019.
- Hartmann, D.L., A.M.G. Klein Tank, M. Rusticucci, L.V. Alexander, S. Brönnimann, Y. Charabi, F.J. Dentener, E.J. Dlugokencky, D.R. Easterling, A. Kaplan, B.J. Soden, P.W. Thorne, M. Wild and P.M. Zhai. 2013. 'Observations: Atmosphere and Surface', in T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley (eds), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 159–254. Cambridge, UK and New York, NY: Cambridge University Press.
- Hegerl, G.C., F.W. Zwiers, P. Braconnot, N.P. Gillett, Y. Luo, J.A. Marengo Orsini, N. Nicholls, J.E. Penner, and P.A. Stott. 2007. 'Understanding and Attributing Climate Change', in by S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds), *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 664–745. Cambridge, UK and New York, NY: Cambridge University Press.
- Intergovernmental Panel on Climate Change (IPCC). n.d. 'Home Page'. Available at <http://www.ipcc.ch/index.htm>, accessed on 31 October 2018.
- . 2013. 'Summary for Policy Makers', in T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung et al. (eds), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 3–32. Cambridge, UK and New York, NY: Cambridge University Press.
- Jansen, E., J. Overpeck, K.R. Briffa, J.-C. Duplessy, F. Joos, V. Masson-Delmotte, D. Olago, B. Otto-Bliesner, W.R. Peltier, S. Rahmstorf,

- R. Ramesh, D. Raynaud, D. Rind, O. Solomina, R. Villalba, and D. Zhang. 2007. "Palaeoclimate", in S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt (eds), *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by M. Tignor and H.L. Miller. Cambridge, United Kingdom, and New York, NY, USA: Cambridge University Press.
- Kothwale, D.R., J.V. Revadekar, and K. Rupa Kumar. 2010. 'Recent Trends in Pre-monsoon Temperature Extremes', *Journal of Earth System Science*, 119(1): 51–65.
- Kulkarni, A.V., I.M. Bahuguna, B.P. Rathore, S.K. Singh, S.S. Randhawa, R.K. Sood, and Sunil Dhar. 2007. 'Glacial Retreat in Himalaya using Indian Remote Sensing Satellite Data', *Current Science*, 92: 69–74.
- Mitchell, John F.B. 1989. 'The "Greenhouse" Effect and Climate Change', *Reviews of Geophysics*, 27(1): 115–39.
- Panda, Architesh. 2009. 'Assessing Vulnerability to Climate Change in India', *Economic & Political Weekly*, 44: 105–17.
- Rajeevan, Madhavan and Shailesh Nayak (eds). 2017. *Observed Climate Variability and Change Over the Indian Region*. Singapore: Springer. Available at www.springer.com/in/book/9789811025303; accessed on 1 January 2017.
- Rajendran, K. and A. Kitoh. 2008. 'The Indian Summer Monsoon in Future Climate Projection by a Super High-Resolution Global Model', *Current Science*, 95(11): 1560–9.
- Reiter, P. 2001. 'Climate Change and Mosquito-borne Disease', *Environmental Health Perspectives*, 109(1): 141–61.
- Shashikanth, K., C.G. Madhusoodhanan, S. Ghosh, T.I. Eldho, K. Rajendran, and R. Murtugudde. 2014. 'Comparing Statistically Downscaled Simulations of Indian Monsoon at Different Spatial Resolutions', *Journal of Hydrology*, 519: 3163–77.
- Shekhar, M.S., H. Chand, S. Kumar, K. Srinivasan, and A. Ganju. 2010. 'Climate-Change Studies in the Western Himalaya', *Annals of Glaciology*, 51(54): 105–12.
- Shrestha, Arun B., Cameron P. Wake, Paul A. Mayewski, and Jack E. Dibb. 1999. 'Maximum Temperature Trends in the Himalaya and Its Vicinity: An Analysis Based on Temperature Records from Nepal for the Period 1971–94', *Journal of Climate*, 12(9): 2775–86.
- Sinha, B., K. Singh Sangwan, Y. Maurya, V. Kumar, C. Sarkar, B.P. Chandra, and V. Sinha. 2015. 'Assessment of Crop Yield Losses in Punjab and Haryana Using 2 Years of Continuous In Situ Ozone Measurements', *Atmospheric Chemistry and Physics*, 15(16): 9555–76.

- Smith, Thomas M. and Richard W. Reynolds. 2005. 'A Global Merged Land–Air–Sea Surface Temperature Reconstruction Based on Historical Observations (1880–1997)', *Journal of Climate*, 18(12): 2021–36.
- Takahashi, K., Y. Honda, and S. Emori. 2007. 'Estimation of Changes in Mortality due to Heat Stress under Changed Climate', *Risk Research*, 10(3): 339–54.
- Unnikrishnan, A.S. and D. Shankar. 2007. 'Are Sea-level-Rise Trends Along the Coasts of the North Indian Ocean Consistent with Global Estimates?', *Global and Planetary Change*, 57(3–4): 301–7.
- Watts, Nick, W. Neil Adger, Paolo Agnolucci, Jason Blackstock, Peter Byass, Wenjia Cai, Sarah Chaytor et al. 2015. 'Health and Climate Change: Policy Responses to Protect Public Health', *The Lancet*, 386(10006): 1861–914.

Changing Climate and Weather

Evidence from Attribution Science

Krishna AchutaRao and Friederike Otto

The levels of scientific evidence in terms of the chain of causality, from anthropogenic climate forcings to local effects on weather and hydrology, impacts affecting societies and loss and damage, are very different. For the first step, from emitters to emissions and concentration, our understanding is very good and we have an inventory of emissions (Chapter 2 in this volume). For the second step, from concentrations to long-term climate change, our understanding with respect to global mean temperature is also very good (Haustein et al. 2017); more patchy for rainfall (Chapter 2 in this volume); and for regional temperatures, the evidence is becoming increasingly strong. The third step in the chain of causality, that is, from global warming to individual weather and climate-related events, is now possible and has been the focus of event attribution studies, but only a handful of such studies currently exist for India. This scientific development now also makes the last step possible, namely, attributing damages and losses from extreme weather to

climate change, but at this point in time, applications have been restricted to a couple of European cities (for example, Mitchell et al. 2016; Schaller et al. 2016).

Being able to more completely understand this causality chain from emissions to localized impacts is crucial and allows for a true assessment of changing risks on the spatial scales (cities and countries rather than continents) decisions are made. Recent publications (for example, Haustein et al. 2017) on the attribution of global mean temperature have analysed, very carefully, the uncertainty in our understanding of the attribution of global mean temperature stemming from a choice of models used and, in particular, from the fact that observations of temperatures at the end of the nineteenth and the beginning of the twentieth centuries are less accurate than today.

After taking all possible sources of uncertainty into account, the finding of this analysis and similar publications is that the observed warming is, with very high confidence, attributable to anthropogenic greenhouse gas (GHG) emissions and that this attributable warming is already at 1°C. This highlights the very high confidence we have in the causal relationship between emissions and global mean temperature, and that at the current rate, the political goal of 1.5 degrees global mean temperature increase is only a few years away.

Anthropogenic GHG emission is, however, not the only driver of climatological change, natural variability as well as other man-made drivers like aerosol pollution play a particularly large role on regional scales. At the same time, drivers outside the climate system, like river management, sewage water systems, and the sheer number of people in harm's way, determine to a large degree the impacts of changing weather and climate. If we, as a society, want to understand what climate change has meant for India so far and estimate how risks are changing, then it is important to disentangle these drivers in order to understand what the adaptation options are. In other words, we need to attribute observed changes to drivers of change and answer the question of whether and to what extent anthropogenic climate change alters the risk of extreme weather.

While the science of attributing extreme weather events is new, it is rapidly growing and over 170 studies have been published worldwide, most of which in the last two years (Schiermeier 2018). These

studies are heavily biased towards regions in Europe and Australia and the types of events attributed are often heatwaves and extreme rainfall events, which are not necessarily the most damaging. However, increasingly, the large number of studies available allows for drawing some general conclusions. In particular for heatwaves, where more than 50 individual events have been analysed, we see very clearly that almost all cases show an increase in the severity and likelihood of the event because of climate change. In two-thirds of all studies, climate change has been found to play a significant role. While not representing every extreme event that has happened in the last years, these studies do not provide a full inventory of climate change impacts. However, it is within this context that the extreme events that have been analysed for India need to be understood. In India, at the moment, there are only three published attribution studies on particular extreme events: record-breaking heat in Rajasthan in 2016; a large-scale heatwave in Andhra Pradesh in 2015; and massive flooding in Chennai in 2015. These studies, while focusing on some of the most damaging events in the last few years, described in detail in this chapter, give a good overview of the methods used in this emerging science and highlight some challenges particular to the Indian context, they do not represent how climate change manifests in India.

Therefore, before introducing the emerging science of extreme event attribution, we will first review the detection and attribution of long-term climate change over India and identify hot spots of regional climate change. We close the chapter with a discussion on the implications of these new scientific developments on policy, politics, and disaster risk reduction, and provide an outlook on where the frontier of the science is likely to move in the coming years.

Long-Term Climate Change

When we think of climate change, we usually associate it with gradual changes in the mean state of the climate—typically over many decades. The global mean temperature, for example, is known to vary due to El Niño events and volcanic eruptions, but has nevertheless seen an increasing trend over the last few decades (Bindoff et al. 2013). On a regional or local level, variations in

temperature and rainfall can be much larger in amplitude, caused by oscillations unique to that place (Chapter 2 in this volume). Any changes resulting from natural factors (such as volcanoes and solar output changes) and human-caused factors (such as GHGs, aerosols, and changes in land use and land cover) are on top of this. Therefore, separating what is natural from what is caused by human activity is hard. The purpose of detection and attribution studies is to be able to separate what is natural from what is human-induced.

The Intergovernmental Panel on Climate Change (IPCC) defines ‘detection’ as the process of demonstrating that climate has changed in some defined statistical sense, without providing a reason for that change. ‘Attribution’ of causes of climate change is the process of establishing the most likely causes for the detected change with some defined level of confidence. Attribution studies typically rely on a ‘fingerprint’—a typical pattern of change—that is unique to the different drivers of climate change. The fingerprint of, say, GHGs is very different from that resulting from aerosol emissions, which is in turn different from those resulting from volcanoes or solar output changes. These fingerprints are deduced from climate models and one statistically analyses the observations to find the strength of each of the patterns. Fundamental to this is the confidence that climate models represent the known science accurately so that the fingerprints may be physically realistic. This involves rigorous validation of models against observations to ensure that they represent the relevant processes and phenomena accurately.

On a global scale, changes in temperature, humidity, and ocean heat content—all indicators of fundamental changes in the earth’s energy balance—have been attributed to anthropogenic causes (Barnett et al. 2005; Bindoff et al. 2013; Gleckler et al. 2012; Jones, Stott, and Christidis 2013; Santer et al. 2007). At regional scales, the human influence on surface temperature has been documented over China and New Zealand, and also in those areas of the Pacific and Atlantic Oceans where tropical cyclones form (Dean and Stott 2009; Gillett, Stott, and Santer 2008; Knutson, Zeng, and Wittenberg 2013; Santer et al. 2006; Xu et al. 2015).

There have been numerous studies that have documented changes in the climate over India, as seen in Chapter 2 in this

volume. Very few of these have focused on attributing the causes of these changes. A recent work by Dileepkumar, AchutaRao, and Arulalan (2018) finds that annual mean temperatures over India can be attributed to anthropogenic causes. The GHGs contribute to a larger warming trend than observed, which is then tempered by the effect of other anthropogenic forcings that tend to exert a cooling effect (such as aerosols and land use–land cover changes). Among the homogeneous temperature zones (classified by Indian Institute of Tropical Meteorology [IITM], Pune, based on climatological features), Western Himalayas, west coast, and east coast regions reveal robust warming across seasons attributable to anthropogenic forcings. Sonali and Kumar (2016) have analysed changes in maximum and minimum temperatures (T_{\max} and T_{\min}) during the second half of the twentieth century and could detect a significant change in T_{\min} but could not attribute it to any specific causative factor.

With increased temperatures, the water vapour holding capacity of the atmosphere increases at about 7 per cent/ $^{\circ}\text{C}$ of warming (Allen and Ingram 2002). This results in larger rainfall totals—much of it coming down as heavy downpours. Mukherjee et al. (2018) have examined observed precipitation records over India and found that the annual maximum rainfall during the period 1979–2015 has increased over much of India, with increases more prominent in southern India than in the north, especially since 1982. Using multiple climate model simulations with and without anthropogenic forcing, they find a clear anthropogenic influence on the frequency of extreme precipitation events. A natural place to look for signals of increased rainfall is in the river basins, which act as integrators of the precipitation. The Mahanadi River basin has been an area of intense research to study the anthropogenic influence from a hydrological perspective. Mondal and Mujumdar (2012) attempted a formal detection and attribution analysis to study the changes in the observed monsoon precipitation and stream flow in the rain-fed Mahanadi River basin. They found that the decreases observed in stream flow and precipitation over the second-half of the twentieth century are consistent with those expected from anthropogenic emissions of GHGs. However, their results were

sensitive to which climate model was used, leading to a less than robust conclusion on the anthropogenic influence.

Extreme Event Attribution

Extreme downpours, heatwaves, and droughts have happened and disrupted public life throughout India's history. Nowadays, with the rising awareness that increasing global mean temperatures will, on average, lead to an increase in the number of heatwaves and more heavy rainfall events, one of the first questions the media, decision makers, and knowledge brokers and politicians ask whenever an extreme weather event takes place is: what the role of climate change was in the particular event?

Two common assumptions have routinely been provided as answers: (i) we are living in a changing climate, so all weather is affected by climate change; and (ii) individual weather events cannot be attributed to anthropogenic climate change. While the former is trivially true and provides no information on whether and to what extent the risk of such an event occurring has changed, the latter is wrong. Scientists are now able to assess how and to what extent the frequency and magnitude of individual types of extreme weather and climate-related events is changing due to human-induced climate change. The method of how to do this is simple in its concept, but complex in its execution. As every extreme weather event is ultimately unique and always the result of a combination of external drivers (solar radiation, volcanoes, GHGs), natural and human-induced, as well as internal climate variability and noise (day-to-day weather conditions), to say with certainty that an event could not have occurred without anthropogenic influence is impossible. It is, however, possible to assess how a particular external driver, namely, GHGs in the atmosphere resulting from burning fossil fuels, alters the probability of an extreme event occurring. To answer the question whether climate change has altered the likelihood of an extreme event to occur, one needs to assess the likelihood of that event in a climate with today's GHG concentration (called the factual or actual climate) and the likelihood in a climate without man-made climate change (called the counterfactual climate). Comparing these two likelihoods gives the role of climate change.

Applying this approach is now possible for an increasing number of extreme weather events. The possible outcomes of an event attribution study are, thus, probabilistic assessments of changing hazards.

In principle, there are two ways in which climate change can affect weather. In a warming world with increasing average temperature, we also expect an increase in extreme temperatures, and thus more and hotter heatwaves and a decrease in cold waves. A warmer atmosphere can also hold more water vapour than a colder one, we therefore expect, on average, more extreme rainfall. However, climate change does not only have this so-called thermodynamic (that is, warming) effect on the climate, but a changing composition of the atmosphere also affects the atmospheric circulation (the so-called dynamics), including the monsoon circulation and where and when tropical cyclones develop. Both effects can work in the same direction and thus increase the change in likelihood of an event more than would be expected from one effect alone, or they can act in the opposite direction and cancel each other out, or one effect can be much stronger than the other. Therefore, every attribution study has a priori four possible outcomes: (i) the event could have been made more likely because of anthropogenic climate change; (ii) it could have been made less likely; (iii) there is no detectable change in the likelihood or magnitude of an event occurring from anthropogenic climate change; or (iv) with current understanding and available climate simulations, it is not possible to robustly assess the role of external drivers in the event.

The approach was introduced by Allen (2003), and subsequently applied to a few European events before 2012 (Stone and Allen 2005; Stott, Stone, and Allen 2004). From 2012 onwards, the science of extreme event attribution has emerged as a field of climate research in its own right (Herring et al. 2014, 2015, 2016, 2018; Peterson et al. 2013a and 2013b), with the first set of attribution studies on extreme weather events in India published in 2016, attributing the floods in Chennai in 2015 (van Oldenborgh et al. 2016) and the heatwave in Andhra Pradesh in the same year (Wehner et al. 2016). A third event attribution study focusing on an event in India has been published in 2018, assessing the role of climate change in the record-breaking extreme temperature in Phalodi in 2016 (van Oldenborgh et al. 2018). The role of climate change is different

in these three events and hence, the results are different. The findings of the Andhra Pradesh heatwave study match what we expect on a global average in a warming climate (Chapter 2 in this volume), where a strong increase in the likelihood of the heatwave to occur is found. We, therefore, use this study to introduce the method of event attribution in more detail, followed by a discussion of the floods in Chennai and the heatwave in Phalodi.

Heatwave in Andhra Pradesh

The main concept behind the probabilistic approach is an assessment of possible weather events of the type of event of interest (for example, a heatwave in Andhra Pradesh, Telangana, and Odisha in the pre-monsoon season of 2015) under present-day climate conditions, and possible weather under counterfactual climate conditions as they would have been without human-induced climate change. Figure 3.1

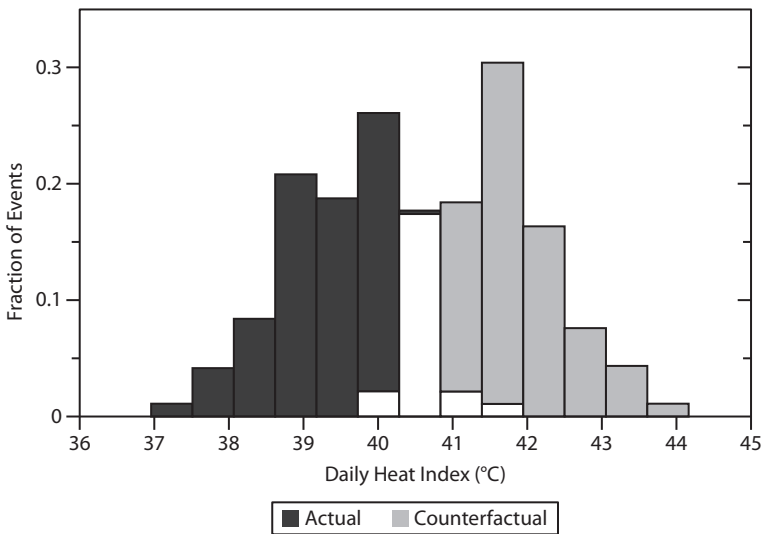


Figure 3.1 Histograms of Possible Daily Maximum Heat Index in Andhra Pradesh for Counterfactual (black) and Actual (light grey) Simulations of May 2015

Source: Adapted from Wehner et al. (2016).

shows an example of the heatwave in Hyderabad in 2015, where the light grey histogram represents possible heat in May in the present-day (actual) climate and the black histogram depicts the distribution of possible heat in May in the counterfactual world. In both worlds, the occurrence frequency of the extreme event can now be calculated and compared. For example, a heat index of 42 would be a relatively frequent event (expected to occur every other year) in the present-day climate, but rather rare (expected to occur once in 50 years) in the counterfactual world. Comparing these two likelihoods of 0.5 and 0.02 would mean that human-induced climate change has made the event 25 times more likely. Wehner et al. (2016) found that human-induced climate change increased the likelihood of a heatwave, like the one observed in Andhra Pradesh, occurring by more than 1,200 per cent, that is, the heatwave was made an order of magnitude (which is more than 10 times) more likely.

While the approach in principle is straightforward, there are different methodologies of estimating possible weather and the likelihood of occurrence of an extreme weather event. Due to the fact that we only have a very limited number of observations of weather events in the present day and no observations of the counterfactual world, event attribution always depends on climate and weather simulations; these can be based on observed or reanalysis data and statistical modelling (for example, van Oldenborgh 2007) or climate model simulations (for example, Lewis and Karoly 2013 and Pall et al. 2011). Each method has advantages and disadvantages, and both observations and climate models are imperfect. Therefore, the most robust estimates of the role of human-induced climate change can be obtained by combining different methodologies (National Academies of Sciences, Engineering, and Medicine 2016). While straightforward in principle—the need for the availability of high-quality data and large ensembles of high-resolution climate model simulation, as well as the fact that these simulations need to be thoroughly evaluated in each individual case—extreme event attribution studies in practice are quite elaborate. In the case of Andhra Pradesh, observations and models aligned and the attribution result is an increase in the risk of heat, and hence what one would expect a priori in a warming world. This is not the case for the Chennai flooding and the heat in Phalodi.

Flooding in Chennai

The first step of every event attribution study relating to a high-impact event is to identify what happened from a meteorological point of view. In the case of flooding, for example, it is often not a priori clear whether a localized, extreme one-day event caused the flood, or whether it was a comparably less extreme event but at the end of a very wet season, and whether the rainfall in the area of the floods was the main cause or whether precipitation further upstream needs to be taken into account as well. Having identified the heaviest one-day rainfall in the region in more than a century as the primary driver behind the flooding, extreme one-day precipitation in the area encompassing 10–15°N, 79.5–81°E was taken as the definition of the event. There will always be a trade-off between what climate models can reliably be expected to simulate and what caused the impact on the ground. Using this definition to assess possible extreme rainfall with and without climate change in statistical modelling and two different climate models, the study found no significant change in the likelihood of the event occurring. Figure 3.2 (between pages 326 and 327) shows the result from one of the climate models, depicted as return time of the event in three different climate model simulations: the year 2015 as observed (red); the year 2015 as it might have been without anthropogenic climate change (blue); and in the current climate in the years before 2015 (green). The overlapping error bars show that the change in likelihood is not significant.

This may seem a surprising result given what we expect in a warming world, but we might be seeing a case of dynamics and thermodynamics working in opposite directions, thus cancelling each other out overall. In other regions of the world, methods have been applied to disentangle these two effects (for example, Vautard et al. 2016). Alternatively, it could be that drivers other than GHGs, such as aerosols, play a role, or the fact that sea surface temperatures in the Bay of Bengal, which are known to influence rainfall, have not increased substantially with global warming. The result highlights that event attribution is clearly different from estimating trends and that the influence of climate change on weather can locally be very different. This fact is highlighted even more by the analysis of heat in Phalodi.

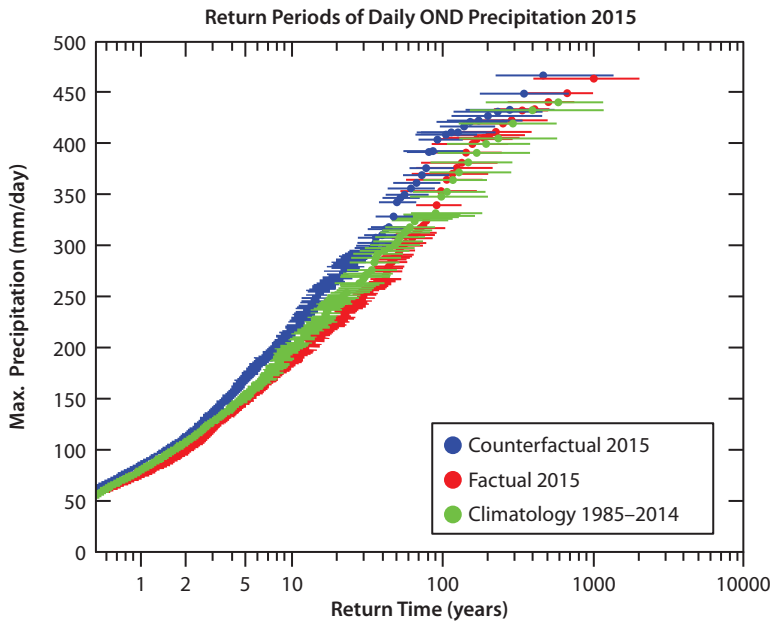


Figure 3.2 Comparison of 2015 Precipitation Extremes over Chennai

Note: Return times of maximum land grid box precipitation in the region 10–15°N, 77–82°E in the Sea Surface Temperature-Forced Regional Model Weather@Home in the 2015 Sea Surface Temperature-Forced Ensemble (red), the 2015 counterfactual world without anthropogenic emissions (blue), and the 1985–2014 Climatology (green).

Source: Adapted from van Oldenborgh et al. (2016).

Extreme Heat in Phalodi, Rajasthan

In 2016 in Rajasthan, the city of Phalodi set a new maximum temperature record for India as it hit 51°C on 19 May 2016. In this case, the event definition was therefore taken as the hottest day of the year (TXx) at the point of Phalodi (grid point closest to the city in climate models). For the model evaluation, observed trends of maximum temperature over India were compared with the trends simulated by models, with the result that the state-of-the-art model simulations that provide the basis for the IPCC fifth assessment report (Coupled Model Intercomparison Project Phase 5 [CMIP5], Taylor, Stouffer, and Meehl 2012) simulate very different trends than the ones observed.

A regional climate model (HadRM3P, Massey et al. 2015) performed better and was included in the analysis. The attribution analysis was thus performed by simulating possible extreme heat in Phalodi, in factual and counterfactual climates, using statistical modelling and observations and the regional climate model. The authors found that the observation-based methodology did not show an increase in the likelihood of maximum temperature, whereas the purely model-based methodology showed a small increase that was, however, not statistically significant. This result is in contrast to the attribution study on the heatwave in Andhra Pradesh (Wehner et al. 2016) and in contrast to attribution of long-term temperature changes in India, discussed earlier. This makes it likely that the effect of anthropogenic climate change may be masked by other external drivers, like aerosols, or local effects, like an increased use of irrigation or other land-use changes. The event attribution study on the heatwave in Phalodi thus resulted in the fourth category of possible outcomes, as without further investigation it is not possible to give a robust result.

While this is not the result one hopes for in an event attribution study, an unclear result like this, however, does not mean that the study was not useful to understand the impact of anthropogenic climate change on heat extremes in India. First, the results show that, in particular locally, drivers other than GHGs have a strong impact on heat. Second, estimating the return time of the event in today's climate, which was more than 40 years in the case of Phalodi heat, is useful information in itself.

Event attribution is an emerging science and currently comprises a very small number of studies globally and over India, in particular. The studies that do exist, however, already show that the impacts of climate change are locally very different, and also differ from event to event. Not all extreme events are being made worse by climate change, while others become orders of magnitude more likely. Thus, the methodology of event attribution provides vital information for adaptation decisions as well as understanding present-day risks.

Discussion

We have discussed the enormous scientific progress that has been made in recent years in understanding not only how emissions affect global temperatures (Chapter 2 in this volume) but also how global temperatures affect regional climate and extreme weather events. The number of studies is still small, but the science has advanced within the last few years to now provide the tools that would allow the development of a more comprehensive overview of what the impacts of global anthropogenic emissions are across India. The last step in this chain of causality, from meteorology and hydrology to impacts on people and assets and loss and damage, has been explored in a handful of studies outside of India (Mitchell et al. 2016; Schaller et al. 2016), and while in these studies a significant increase in mortality and flooded properties, respectively, has been attributed to anthropogenic climate change, damages and losses of life crucially depend on the vulnerability and exposure. For example, in a city like Ahmedabad that has a heat action plan, excess mortality due to heat could be orders of magnitude lesser than in cities without an action plan (Knowlton et al. 2014).

The levels of scientific evidence for mitigation and adaptation are still different, but the gap has begun to close. These differing levels, however, have consequences on the basis of policy decisions on mitigation, adaptation, loss and damage, and disaster risk management. With respect to mitigation, while the exact carbon budget to limit global warming to 1.5°C or 2°C is uncertain, the fact that global emissions need to reach zero within this century is certain, and thus mitigation questions are more political, moral, and economic than scientific. In

terms of adaptation, however, the scientific evidence is more uncertain for regional changes in temperature and precipitation—in particular for localized and extreme events. It is these scales of cities and municipalities where adaptation takes place. With the rapid development of the science of attributing extreme weather events to anthropogenic climate change in the last few years and the application of traditional detection and attribution methodologies on a regional scale, it is now increasingly possible to assess the role of anthropogenic climate change on scales relevant for risk management and adaptation planning.

As the examples across the world show (for example, Herring et al. 2016), attribution assessments are relatively straightforward for some kinds of events, while others represent the current boundary of the rapidly evolving field. What type of climate and weather events belong in which category depends not only on the event itself but also on data availability and understanding of local meteorology. In particular, in comparatively data-poor regions and for more complex events like droughts, uncertainties are still rather high.

At the same time, it is at these kinds of places and events where climate change and development challenges meet and are at risk to be played against each other. Recent extreme weather events have been associated with poor harvests, water shortages, and forced migration in communities struck by floods, droughts, and tropical cyclones. Stories, photographs, and videos of this destruction have frequently been used as evidence of the impacts of anthropogenic climate change; for example, by journalists, campaigners, and researchers in the climate adaptation and development/aid community (for example, blogs and newspapers¹). Such coverage implies that global warming is making these extreme weather events more frequent and intense, and that for every damaging event climate change is to blame. Examples discussed here show that this is not always the case, and incorrect attribution stemming from misunderstanding or for political reasons will, in the long term, prohibit spending sparse resources on adapting to those kinds of impacts where climate change

¹ Some examples are Gsottbauer and Gampfer (2014), Goldenberg (2014), Saño (2013), and Wojewoda (2014).

is really a game changer. The findings from the very limited body of event attribution literature in India show that climate change is not a major player in two of the three events. This highlights the importance of taking other drivers of extreme weather into account in decision making.

However, at the same time, while long-term predictions cannot provide the only guide to adaptation planning, attribution results need to be understood across timescales. Even though today a heatwave in Phalodi has not been made more likely due to climate change, this will likely change in the future when the climate signal surpasses the masking drivers. Model simulations of the likelihood of the 2016 heatwave occurring in a world of 1.5°C and 2°C higher global mean temperatures indicate a doubling and fivefold increase, respectively (Otto et al. 2018).

In conclusion, to interpret these findings from the attribution literature in India, three things are important: first, the sample of India studies to date is small and has to be read with the broader global literature which finds that global warming plays a substantial role in the majority of extreme events worldwide. With a broader range of India studies, the overall picture might well look different. Second, whether and to what extent the overall risk of an extreme event is changing is only partly a question of what happens with the hazard. Vulnerability and the number of people and assets in harm's way determine, to a large degree, losses and damages of extreme events. Last, event attribution is very powerful because it applies on the scales decisions are made and where people feel the impacts of changing risks. Analysing events that have already happened is concrete and resonates much better with people than abstract future information. However, in order to make the right decisions for the future, attribution assessments and climate projections need to be combined. The scientific development of event attribution has made it possible but, for India, this now needs to be implemented.

References

- Allen, Myles. 2003. 'Liability for Climate Change', *Nature*, 421(6926): 891–92.

- Allen, M.R. and W.J. Ingram. 2002. 'Constraints on Future Changes in Climate and the Hydrologic Cycle'. *Nature*, 419(6903): 224–32. Available at <https://doi.org/10.1038/nature01092>.
- Barnett, Tim P., David W. Pierce, Krishna M. AchutaRao, Peter J. Gleckler, Benjamin D. Santer, Jonathan M. Gregory, and Warren M. Washington. 2005. 'Penetration of Human-Induced Warming into the World's Oceans', *Science*, 309(5732): 284–7.
- Bindoff, Nathaniel L., Peter A. Stott, Krishna M. AchutaRao, Myles R. Allen, Nathan Gillett, David Gutzler, Kabumbwe Hansingo et al. 2013. 'Detection and Attribution of Climate Change: From Global to Regional', in T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley (eds), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY: Cambridge University Press.
- Dean, S.M. and P.A. Stott. 2009. 'The Effect of Local Circulation Variability on the Detection and Attribution of New Zealand Temperature Trends', *Journal of Climate*, 22(23): 6217–29.
- Dileepkumar, R., K. AchutaRao, and T. Arulalan. 2018. 'Human Influence on Sub-regional Surface Air Temperature Change over India', *Scientific Reports*, 8(1): 8967. Available at <http://dx.doi.org/10.1038/s41598-018-27185-8>.
- Gillett, N.P., P.A. Stott, and B.D. Santer. 2008. 'Attribution of Cyclogenesis Region Sea Surface Temperature Change to Anthropogenic Influence.' *Geophysical Research Letters*, 35(9). Available at <http://dx.doi.org/10.1029/2008gl033670>.
- Gleckler, P.J., B.D. Santer, C.M. Domingues, D.W. Pierce, T.P. Barnett, J.A. Church, K.E. Taylor, K.M. AchutaRao, T.P. Boyer, M. Ishii, P.M. Caldwell. 2012. 'Human-Induced Global Ocean Warming on Multidecadal Timescales', *Nature Climate Change*, 2(7): 524–9. Available at <https://doi.org/doi:10.1038/nclimate1553>.
- Goldenberg, Suzanne. 2014. 'Eight Ways Climate Change Is Making the World More Dangerous', *The Guardian*, 14 July. Available at <https://www.theguardian.com/environment/blog/2014/jul/14/8-charts-climate-change-world-more-dangerous>; accessed on 13 May 2019.
- Gsottbauer, E. and R. Gampfer. 2014. 'Liability mechanism to strike an ambitious climate agreement'. *ETH News*. Available at <https://www.ethz.ch/en/news-and-events/eth-news/news/2014/08/liability-mechanism-to-strike-an-ambitious-climate-agreement.html>; 13 May 2019.
- Haustein, K., M.R. Allen, P.M. Forster, F.E.L. Otto, D.M. Mitchell, H.D. Matthews, and D.J. Frame. 2017. 'A Real-time Global Warming Index', *Scientific Reports*, 7(1): 15417.

- Herring, Stephanie C., Martin P. Hoerling, James P. Kossin, Thomas C. Peterson, and Peter A. Stott. 2015. 'Explaining Extreme Events of 2014 from a Climate Perspective', *Bulletin of the American Meteorological Society*, 96(12): S1–172.
- Herring, Stephanie C., Martin P. Hoerling, James P. Kossin, Carl J. Schreck III, and Peter A. Stott. 2016. 'Explaining Extreme Events of 2015 from a Climate Perspective', *Bulletin of the American Meteorological Society*, 97(12): S1–145.
- Herring, S.C., M.P. Hoerling, T.C. Peterson, and P.A. Stott. 2014. 'Explaining Extreme Events of 2013 from a Climate Perspective', *Bulletin of the American Meteorological Society*, 95(9): S1–96.
- Herring, S.C., N. Christidis, A. Hoell, J.P. Kossin, C.J. Schreck, and P.A. Stott. 2018. 'Explaining Extreme Events of 2016 from a Climate Perspective'. *Bulletin of the American Meteorological Society*, 99(1): S1–157. Available at <https://doi.org/10.1175/BAMS-ExplainingExtremeEvents2016.1>.
- Jones, Gareth S., Peter A. Stott, and Nikolaos Christidis. 2013. 'Attribution of Observed Historical Near-Surface Temperature Variations to Anthropogenic and Natural Causes Using CMIP5 Simulations', *Journal of Geophysical Research: Atmospheres*, 118(10): 4001–24.
- Knowlton, Kim, Suhas P. Kulkarni, Gulrez Shah Azhar, Dileep Mavalankar, Anjali Jaiswal, Meredith Connolly, Amruta Nori-Sarma et al. 2014. 'Development and Implementation of South Asia's First Heat-Health Action Plan in Ahmedabad (Gujarat, India)', *International Journal of Environmental Research and Public Health*, 11(4): 3473–92.
- Knutson, Thomas R., Fanrong Zeng, and Andrew T. Wittenberg. 2013. 'Multimodel Assessment of Regional Surface Temperature Trends: CMIP3 and CMIP5 Twentieth-Century Simulations', *Journal of Climate*, 26(22): 8709–43.
- Lewis, Sophie C. and David J. Karoly. 2013. 'Anthropogenic Contributions to Australia's Record Summer Temperatures of 2013'. *Geophysical Research Letters*, 40(14): 3705–9.
- Massey, N., R. Jones, F.E.L. Otto, T. Aina, S. Wilson, J.M. Murphy, et al. 2015. 'Weather@Home--Development and Validation of a Very Large Ensemble Modelling System for Probabilistic Event Attribution'. *Quarterly Journal of the Royal Meteorological Society*. Available at <https://doi.org/10.1002/qj.2455>.
- Mitchell, D., C. Heavyside, S. Vardoulakis, C. Huntingford, G. Masato, B.P. Guillod, P. Frumhoff, A. Bowery, D. Wallom, and M. Allen. 2016. 'Attributing Human Mortality During Extreme Heat Waves to

- Anthropogenic Climate Change'. *Environmental Research Letters*, 11(7). Available at <https://doi.org/10.1088/1748-9326/11/7/074006>.
- Mondal, A. and P.P. Mujumdar. 2012. 'On the Basin-scale Detection and Attribution of Human-Induced Climate Change in Monsoon Precipitation and Streamflow', *Water Resources Research*, 48(10). Available at <http://dx.doi.org/10.1029/2011wr011468>.
- Mukherjee, Sourav, Saran Aadhar, Daithi Stone, and Vimal Mishra. 2018. 'Increase in Extreme Precipitation Events under Anthropogenic Warming in India', *Weather and Climate Extremes*, 20: 45–53. Available at <https://doi.org/10.1016/J.WACE.2018.03.005>.
- National Academies of Sciences, Engineering, and Medicine. 2016. 'Attribution of Extreme Weather Events in the Context of Climate Change'. National Academies Press. Available at <https://doi.org/10.17226/21852>.
- Otto, Friederike E.L., Sjoukje Philip, Sarah Kew, Sihan Li, Andrew King, and Heidi Cullen. 2018. 'Attributing High-impact Extreme Events across Timescales—A Case Study of Four Different Types of Events', *Climatic Change*, 149(3–4): 399–412.
- Pall, P., T. Aina, D.A. Stone, P.A. Stott, T. Nozawa, A.G. Hilberts, D. Lohmann, and M.R. Allen. 2011. 'Anthropogenic Greenhouse Gas Contribution to Flood Risk in England and Wales in Autumn 2000'. *Nature*, 470: 382.
- Peterson, T.C., M.P. Hoerling, S.C. Herring, P.A. Stott, eds. 2013a. 'Explaining Extreme Events of 2012: From a Climate Perspective'. *Bulletin of the American Meteorological Society*, 94(12): S1–74.
- Peterson, T.C., M.P. Hoerling, P.A. Stott, and S.C. Herring. 2013b. 'Explaining Extreme Events of 2012 from a Climate Perspective', *Bulletin of the American Meteorological Society*, 94(9): S1–74.
- Saño, Naderev. 2013. 'Typhoon Haiyan: We Cannot Afford to Procrastinate on Climate Action', *The Guardian*, 11 November. Available at <https://www.theguardian.com/world/2013/nov/11/typhoon-haiyan-philippines-climate-change>; accessed on 13 May 2019.
- Santer, B.D., C. Mears, F.J. Wentz, K.E. Taylor, P.J. Gleckler, T.M.L. Wigley, T.P. Barnett et al. 2007. 'Identification of Human-Induced Changes in Atmospheric Moisture Content', *Proceedings of the National Academy of Sciences*, 104(39): 15248–53.
- Santer, B.D., T.M.L. Wigley, P.J. Gleckler, C. Bonfils, M.F. Wehner, K. AchutaRao, T.P. Barnett et al. 2006. 'Forced and Unforced Ocean Temperature Changes in Atlantic and Pacific Tropical Cyclogenesis Regions', *Proceedings of the National Academy of Sciences*, 103(38): 13905–10.

- Schaller, N., A.L. Kay, R. Lamb, N.R. Massey, G.J. van Oldenborgh, F.E.L. Otto, S.N. Sparrow, R. Vautard, P. Yiou, I. Ashpole et al. 2016. 'Human Influence on Climate in the 2014 Southern England Winter Floods and Their Impacts'. *Nature Climate Change*, 6: 627–34. Available at <https://doi.org/10.1038/nclimate2927>.
- Schiermeier, Quirin. 2018. 'Droughts, Heatwaves and Floods: How to Tell When Climate Change is to Blame', *Nature*, 560: 20–2.
- Sonali, P. and D. Nagesh Kumar. 2016. 'Detection and Attribution of Seasonal Temperature Changes in India with Climate Models in the CMIP5 Archive', *Journal of Water and Climate Change*, 7(1): 83–102.
- Stone, D.A. and M.R. Allen. 2005. 'The End-to-End Attribution Problem: From Emissions to Impacts'. *Climatic Change*, 71(3): 303–18. Available at <https://doi.org/10.1007/s10584-005-6778-2>.
- Stott, Peter A., Dáithí A. Stone, and Myles R. Allen. 2004. 'Human Contribution to the European Heatwave of 2003', *Nature*, 432(7017): 610–14.
- Taylor, K.E., R.J. Stouffer, and G.A. Meehl. 2012. 'An Overview of {CMIP5} and the Experiment Design'. *Bulletin of the American Meteorological Society*, 93: 485–98. Available at <https://doi.org/10.1175/BAMS-D-11-00094.1>.
- van Oldenborgh, G.J. 2007. 'How Unusual was Autumn 2006 in Europe?', *Climate of the Past Discussions*, 3(3): 659–68.
- van Oldenborgh, G.J., Friederike E.L. Otto, Karsten Haustein, and Krishna AchutaRao. 2016. 'The Heavy Precipitation Event of December 2015 in Chennai, India', *Bulletin of the American Meteorological Society*, 97(12): S87–91.
- van Oldenborgh, G.J., S. Philip, S. Kew, M. van Weele, P. Uhe, F. Otto, R. Singh, I. Pai, H. Cullen, and K. AchutaRao. 2018. 'Extreme Heat in India and Anthropogenic Climate Change'. *Natural Hazards and Earth System Sciences*, 18(1): 365–81. Available at <https://doi.org/10.5194/nhess-18-365-2018>.
- Vautard, Robert, Pascal Yiou, Friederike Otto, Peter Stott, Nikolaos Christidis, Geert Jan van Oldenborgh, and Nathalie Schaller. 2016. 'Attribution of Human-Induced Dynamical and Thermodynamical Contributions in Extreme Weather Events', *Environmental Research Letters*, 11(11): 114009.
- Wehner, Michael, Dáithí Stone, Hari Krishnan, Krishna AchutaRao, and Federico Castillo. 2016. 'The Deadly Combination of Heat and Humidity in India and Pakistan in Summer 2015', *Bulletin of the American Meteorological Society*, 97(12): S81–6.

- Wojewoda, Nicolò. 2014. 'Europe: Climate Impacts have Never Hit Closer to Home', 350.org, 29 March. Available at <https://350.org/europe-climate-impacts-have-never-hit-closer-to-home/>; accessed on 13 May 2019.
- Xu, Ying, Xuejie Gao, Ying Shi, and Zhou Botao. 2015. 'Detection and Attribution Analysis of Annual Mean Temperature Changes in China', *Climate Research*, 63(1): 61–71. Available at <http://www.int293res.com/abstracts/cr/v63/n1/p61-71/>; accessed on 13 May 2019.

Impacts of Global Warming in India*

Narratives from Below

Nagraj Adve

Climate change can often appear as a distant, abstract issue. Evidence of climate change is often presented in terms of long-term averages, such as the fact that the earth is currently, after accounting for natural fluctuations, 1.1°C warmer than the 1880–1920 average,¹ or that India has warmed by about 0.8°C since 1901.² Invaluable as the science has been, and grave as these numbers are, abstract data

* A brief word about the method followed. This chapter is based on multiple sources: interviews and conversations with people in, and from, different states; scientific papers; India Meteorological Department (IMD) and Indian Institute of Tropical Meteorology (IITM) publications; non-governmental organization (NGO) literature; state action plans on climate change; people's testimonies at public hearings; public meetings; and one film. Through this, it seeks to provide narratives of global warming in India from below.

¹ National Aeronautics and Space Administration/Global Surface Temperature Analysis data, quoted in Hansen et al. (2019).

² This figure is based on long-term records and current trends. The rise in both maximum and minimum temperatures has accelerated in India

often does not adequately communicate the impacts of these changes on people's lives. This chapter seeks to address this issue by using ethnographic and documentary material to look at how people experience and negotiate climate change in parts of India. Using such an approach, it aims to provide a qualitative narrative of some key, current impacts of global warming.

Drawing out this narrative is complicated by the fact that anthropogenic factors other than greenhouse gases (GHGs) also often have a role to play in a changing climate, such as land use changes, increased atmospheric pollutants (Roxy et al. 2017), and urbanization. Over the last few years, climate science has made remarkable strides in a growing literature on attribution (Chapter 3 in this volume), which seeks to examine whether the occurrence of a specific extreme climate event—events of extreme rainfall, drought, or acute heat stress—was made more probable due to anthropogenic warming.

It is also made more challenging by the fact that specific impacts in a particular place or context are mediated by far-reaching social changes, such as a partly changing agrarian reality, gender relations, caste dynamics, the spread and deepening of capitalism in India, and growing inequalities in incomes, housing, and wealth. Basically, two complex systems—the climate and the social—are both changing in myriad ways, while continuing to influence each other. Unpacking the relative effect of all these intersecting drivers is not easily done, nor is it the intention of this chapter, but their relevance is best not forgotten.

This chapter presents some key, current impacts of global warming in India to examine how the lives of people, as well as other species, are likely affected. For want of space, the discussion does not include some other important changes unfolding: for instance, an increase in the frequency and duration of heat stress, which has been causing thousands of deaths in India in recent years (Rohini, Rajeevan, and Srivastava 2016); or the increased variability, particularly in the monsoon, over the last few decades. In fact, in many places, farmers now say that the rains have become very unpredictable: it rains when it should not and does not rain when it should (Public Advocacy Initiatives for Rights and Values in India [PAIRVI] 2010). There has been a tripling of geographically widespread extreme rainfall events

since 1981; our average temperature is currently rising by 0.17°C per decade (Srivastava, Kothawale, and Rajeevan 2017: 20).

during 1950–2012 (Roxy et al. 2017). The southwest monsoon, so crucial to Indian agriculture, has been lessening overall in most regions of the country, for which the Indian Ocean warming faster than the Indian landmass has a crucial role to play (Roxy et al. 2015). There has also been a significant increase in the area and intensity of monsoon droughts since the mid-1950s (Pai et al. 2017: 78). The effects of these changes on crucial sectors of the Indian society and economy—say, agriculture and water, to name just two—are discussed in other chapters in this volume.

Sea-Level Rise, Displacement, and Livelihoods

The Sunderbans, the vast deltaic ecosystem straddling India and Bangladesh, is home to 4.3 million people in India, 1.5 million of them below the poverty line. The level of displacement people face here is staggering. ‘My earliest home was way over there,’ said a 60-year-old farmer, Bishnu Majhi, pointing to the sea. ‘There were houses owned by other families even farther. They have all moved inland.’³

This conversation took place in front of his third home, located at one edge of Sagar Island. The land in front of the house was barren, the small water body on it rendered saline; all along that stretch of coast were abandoned homes, former agricultural land, and broken trunks of dead coconut trees jutting into the sky, creating a surreal landscape. Packed sandbags were piled up to one side of his front door, used as a barricade when the tide came in during the monsoon months. ‘When that happens, where we are now standing, there is water up to our knees,’ he said. ‘Despite the sandbags, some water seeps into the house,’ his wife Jyotsna added. For tens of thousands of people here, encroaching waters is a fact of life. Now, for many, all their childhood memories are under water.

There are multiple factors, natural and anthropogenic, causing waters to encroach on lands in the Sunderbans. The Ganga–Brahmaputra–Meghna delta is subsiding at 2.5 millimetres (mm) a year, a combination of geology, soil compaction, groundwater

³ Personal interviews conducted during a field visit to the Sunderbans in January 2014. All translations from Bengali courtesy Partha Kayal, whose engagement with the Sunderbans has been long-standing, and Amitabha Kar.

extraction, and sediment supply (Payo et al. 2016). There is also erosion and accretion caused by riverine ebbs and flows, but it is likely that a growing factor is absolute sea-level rise, caused by global warming.⁴

Climate change-induced sea-level rise occurs for two key reasons: one, over 90 per cent of the excess heat trapped by GHGs since 1971 has gone into oceans worldwide, causing the warmer waters to expand; two, melting ice from glaciers and the fact that the great ice sheets on Greenland and West Antarctica 'are losing mass at an accelerating rate' (National Snow and Ice Data Center 2018).

These various factors combined contribute to a relative sea-level rise in the Sunderbans that seems to be accelerating: one study put the rate at 3.14 mm/year at Sagar Island between 1985 and 1998 (Hazra et al. 2002). However, a more recent, authoritative analysis of data from the same observatory at Sagar over the past 25 years stated, 'The rate of relative sea-level rise comes close to 8 mm/year' (Ghosh et al. 2016: 9).

The physical effects of this sea-level rise here are greater coastal erosion, increased saltwater intrusion, and more inundation. Its social effects are severe, more so in a context of serious deprivation: five out of every six homes in the Sunderbans do not have grid-based electricity; and one in three has no access to health care. In a detailed survey of income levels, landholding size, and asset ownership, 18 out of 19 blocks across the Sunderbans were found to be moderately or highly economically vulnerable, with large overlaps between vulnerability and the proportion of Scheduled Caste households (Hazra et al. 2014). About 78 per cent of households surveyed engage in agriculture—rice being the chief crop—in addition to fishing. Though there are a few large landowners—some of the better-off ones grow the more lucrative betel crop—most households have small landholdings, or are landless.

The erosion or salination of agricultural land intensifies this vulnerability. 'We used to have 12 *bighas*,' said a farmer, Himanshu Jena. 'Six have been swallowed by the water.' As a consequence, forced migration is a constant feature as people join the labouring poor in Kolkata and farther afield to find work. This results in the frequent fracturing of families and communities.

⁴ Absolute sea-level rise refers to the rise in sea-levels alone; relative sea-level rise includes natural processes like land subsidence.

Many households have been displaced multiple times. In Gobardhanpur village in South 24 Parganas district—a village of about 300 households, over a hundred of whom had lost land to encroaching waters—Shankar Das, a small farmer, said he had to shift his home three times. ‘Land is much more difficult to find now,’ said one old couple who had moved even more often. Numerous people had shifted home no less than three times. In every case, the land they owned was significantly less than they had earlier.

Many farmers have switched to growing salt-tolerant indigenous rice varieties, such as Dudeswar, particularly after Cyclone Aila hit in 2009. The other key attempt at adaptation is collective in nature. ‘We wrote to the Block Development Officer with seventy signatures, requesting a proper embankment; little has come of it,’ said a group of women who run an NGO. This is an oft-repeated refrain across the Sunderbans—the demand for embankments where they don’t exist and for sturdier embankments made of stone where mud embankments do. One Left political party’s poster in Patharpratima block reflected this widely-felt demand: ‘If you want an embankment,’ it stated in Bengali, ‘vote for us.’

The effects of sea-level rise extend beyond individual households, to impacts on the community, such as on schools, which are critical for the life trajectories of the young, and for future generations. Boatkhali Kadambini Primary School, at one edge of Sagar Island, which was a flourishing school protected by a mud embankment in 2014, was completely destroyed by the advancing waters in late 2017. As a senior teacher, who shared photographs and a video of the destroyed school building, said, ‘The sea water has come in permanently a hundred metres beyond the spot where our school used to be. Last year, we had to move to a makeshift structure 500 metres inland.’⁵ The entire stretch, where there were once houses and plots of land, had turned barren.

For India, the Sunderbans is like the proverbial canary in the coal mine; we would do well to pay heed. With accelerating sea-level rise, communities along much of India’s 7,500 kilometre (km) coastline will have to cope with Sunderbans’ present reality some years from

⁵ Utpal Giri, personal conversation, Sagar Island, the Sunderbans, 5 December 2017.

now. Millions of people will likely face coastal erosion, destruction of their agricultural lands, storm surges, forced migration, and potential conflict, on a horrifying scale.

Migration of Species

Global warming also has drastic effects on other species, with implications for different communities. Until about 1985, a key marine species, the oil sardine, used to be found in waters of the Malabar upwelling zone. Over the last 30 years, it has extended its range, from about 14°N to 20°N (Vivekanandan 2011: 25–6). In other words, it has travelled north by about 650 km, well beyond Mumbai, and can now be found along the south Gujarat coast. The Indian mackerel has also extended its range similarly.

A meta-survey of 208 published studies covering 857 marine species found similar phenomena happening across the world's oceans (Poloczanska et al. 2013). Sea surface temperatures have increased worldwide by about 0.4°C on average over the past 40 years (Schiermeier 2017). The Indian Ocean, however, is warming at a much faster rate than other oceans; waters around India's coasts have warmed by about 0.14–0.16°C/decade over 1958–2015 (Gnanaseelan, Roxy, and Deshpande 2017: 169). According to a specialist on marine species in India, there is a 'positive correlation' between rising sea surface temperatures and the extension of these species' ranges northward: 'The warmer tongue (27°C–28.5°C) of the surface waters expanded north of 14°N, enabling the oil sardine and Indian mackerel to extend their distributional boundary' (Vivekanandan, Hermes, and O'Brien 2016).

As a result, according to a Central Marine Fisheries Research Institute (CMFRI) study, the Indian mackerel has become more prominent and extended its range north off India's east coast as well. And oil sardines were not present at all off India's south-east coast until the mid-1970s, but have spread there in a major way since the 1980s (Vivekanandan 2011: 26, 29–30).

These extensions in range have also had a profound impact on the livelihood practices of some fishing communities. In Tamil Nadu, for instance, it catalysed changes in gear and fishing practices. According to a researcher and activist in the area:

Ring seine nets increasingly made their appearance to catch these new fish arrivals. As these nets are too expensive for any average fishing household, 10–30 households would get together and invest the ₹5 million or more needed to purchase them. It is also a means by which capital is coming from outside the community, either as credit or from shareholders who are not necessarily fishers.⁶

These changes add to the challenges faced by fishers, particularly artisanal fishers, for other, non-climatic reasons, such as resource depletion, smaller size/below maturity of fish being caught, and rising input costs (Food and Agricultural Organization [FAO]/Foundation for Ecological Research, Advocacy and Learning [FERAL] 2008), all of which could adversely affect catch rates and returns, catalysing tensions.

The changes are unlikely to end there. As their temperatures continue to rise, Malabar's waters could well get too warm for these species. This has happened with catfish along both coasts: as the temperature of the southern waters rose beyond 29°C over the last decade, they completely shifted north, where the water temperature is still 27°C–28.5°C (Vivekanandan, Hermes, and O'Brien 2016: 50). That the same shift may occur down south with the mackerel and oil sardine, both crucial to the nutrition and incomes of millions, is sobering food for thought.

Himalayan Effects

Shifts in species' range are happening on land as well, particularly in the Himalayas. Average temperatures across the Hindu Kush Himalaya (HKH) have risen by 1.19°C in the period 1901–2014, with 'dramatic warming' after the 1970s (Ren et al. 2017: 150). It has contributed to an upward shift in the ranges of fruits, vegetables, oak trees, reptiles, birds, and other fauna across the Himalayan states, as these species find temperatures to which they are accustomed higher up (Adve 2014).

Krishna Mahant, a 60-year-old apple farmer from Hurla village of Kullu district, at about 4,000 feet, wistfully remembered better

⁶ Dr Senthil Babu, personal communication, Puducherry, 12 January 2018.

times: 'I was about ten years old. Our village had lots of apple trees. Apples would get transported to Delhi and Punjab' (Jodha 2005). In Himachal Pradesh, land reforms in the 1950s and, later, state support for horticulture were key to improved livelihoods and standards of living for many. Nonetheless, the average temperature, maximum temperature, and average winter temperatures have all risen in Himachal Pradesh sharply between 1951 and 2010 (Rathore, Attri, and Jaswal 2013). This has resulted in reduced snowfall at many altitudes, including in Mahant's village: 'It needs at least six inches of snow for apples to flourish, which we used to get twenty years ago. Nowadays, even if we get an inch of snow, it's unusual. Today there are no apples in this village' (Jodha 2005).

In contrast, in places that used to be too cold for apple cultivation, farmers have benefited. 'With apples growing here for the past twenty years, people's incomes have suddenly risen,' says Bishan Thakur of Nushala village. At even higher altitudes, such as in Lahaul Valley at 10,500 feet, expanding apple cultivation has boosted farm incomes significantly, even as they have declined in villages lower down, in Palam Valley (Rana et al. 2013). Farmers in the Eastern Himalayas have benefited as well: mandarin oranges and round chillies, a high-value crop, are growing in the Darjeeling Hills at altitudes they could not earlier.⁷ However, how long will these windfalls last as these crops continue their climb upward?

Rising temperatures are having other effects across the Himalayan ecosystem. An agricultural scientist from Srinagar told me what it has meant for one of Kashmir's iconic tourism destinations:

The Dal Lake used to be frozen thick in winters 25–30 years ago. I have played cricket on the lake, driven my motorbike on it; someone I know had driven his car on the Dal Lake. Nowadays it has a thin and unsafe layer of ice. ... Snowfall began lessening about fifteen years ago. The timing and patterns of the snowfall have also changed.⁸

'There's a lot of reporting in Kashmir about global warming when we get less snow or erratic rain,' a professor of political science at

⁷ Samuel Thomas, personal communication, Darjeeling, 9 March 2014.

⁸ Dr Nayar Kirmani, personal communication, Delhi, 2 March 2015.

the University of Kashmir told me in January 2018. ‘Students, and others, are very aware of the problem. They see afforestation as the way forward,’ he added.⁹

In Uttarakhand, people’s responses during interviews by the People’s Science Institute (PSI) pointed to clear perception of rising temperatures, unpredictable seasons, and reduced snowfall, particularly of farmers who face crop failure as a consequence. In the Pindar Valley, where pastoralism is an important livelihood, *bugyals* (alpine meadows) are being taken over by thorny bushes, and these meadows are moving higher away from villages. This detailed study of climate change and new variability in the Bhagirathi and Pindar valleys emphasizes decreased precipitation and reduced winter rainfall. The ‘drastic decrease in snowfall’ has reduced the snow cover of the mountains surrounding the Pindar Valley, and consequently adversely affected water availability in streams and rivers in the summer months (PSI 2010).

At a public hearing, a resident of Chamoli district said, ‘Our agriculture, social activities, and entire knowledge system were often determined and regulated by regular climate patterns. But now we are losing all sense of climate ... Because of little snowfall, numerous water sources in the region have dried up. This has depleted soil fertility.’¹⁰ Women are affected the most by this crisis of water, having to queue up for water from early morning, and take the help of their children before they go to school. In May–June, when the crisis is most acute, the better-off use ponies and tempos to fetch water from long distances; the relatively poor just walk (Centre for Science and Environment [CSE] 2017: 64–5).

Extreme Rainfall in Uttarakhand

Over four days in June 2013, most of Uttarakhand received ‘unprecedented very heavy rainfall’, including 482 mm in Dehradun on 16–17 June. Scientists commented on how rapidly and early the monsoon had advanced and how wide an area in the state faced this deluge (Sikka et al. 2015). A landmark study in the *Bulletin of the*

⁹ Dr Javid Ahmed, personal communication, Delhi, 4 January 2018.

¹⁰ A speaker at the National People’s Tribunal on Climate Change, Delhi, 2010.

American Meteorological Society concluded that ‘our analyses of the observed and simulated June precipitation provide evidence that anthropogenic forcing of the climate system has increased the likelihood of such an event’ (Singh et al. 2014: S61).

Massive volumes of water suddenly engulfed Kedarnath, following 325 mm of rain in 24 hours around Chaurabari glacier and accumulated water bursting through the moraine of its glacial lake. Thousands of tourists, shop owners, employees, and innumerable workers in the tourism industry were swept away in the deluge or trapped under the huge volume of mud, boulders, and debris. The floods are an indicator of the massive damage that could occur if predictions of a climate change-driven increase in extreme rainfall events come true.

The Uttarakhand government said 580 had died and another 6,453 were missing and presumed dead. Over 3.4 million were affected (Shrestha, Grabs, and Khadgi 2015: 241). The exact number of those who died will never be known and could be much higher, partly because there were so many Nepali and Indian migrant workers there since it was the height of the tourist season. At a public meeting organized by the Uttarakhand Aapda Rahat Manch in August 2013, a team, including doctors who extensively surveyed and set up medical relief camps in Ukhimath tehsil, Rudraprayag, reported that 595 people had died in Ukhimath alone, including 176 students, of which 144 were aged between 9–16 years. ‘The women are particularly affected by the deaths of family members; some of them are ill but they do not say anything.’¹¹

The loss and damage to livelihoods was also extensive: shops were washed away; and many lost their mules, used commonly for transporting goods and people, as well as their cows and other livestock kept for manure and the sale of milk to tea shops. There was widespread damage to agricultural land from being directly washed away into rivers, or being submerged by debris and silt. Numerous landslides damaged terrace farming, the major method of farming in hilly terrains. The standing crop was washed away (Adusumalli, Dutta, and Jha 2013).

¹¹ Munish Kumar of the Uttarakhand Aapda Manch, speaking at a public meeting in the Gandhi Peace Foundation, Delhi, 7 August 2013.

While the Uttarakhand disaster cannot as yet conclusively be directly tied to climate change based on current scientific evidence, it does urge us to rethink deeply what may be appropriate development for any place. In the aftermath of the disaster, experts questioned the blasting of tunnels in a fragile mountain ecosystem, 'ill-conceived' hydropower projects, and the 'hotels and land developers [who] have encroached on river banks' (Chopra 2013). The Ravi Chopra Expert Body report recommended that all hydroelectric projects above the winter snowline, and projects that encompass critical wildlife habitats, eco-sensitive zones, and wildlife-protected areas, be rejected. It implicitly calls into question the dominant hydropower energy policy across the Himalayan states. In a likely context of more frequent intense rainfall events, vulnerable regions need more sensible land use and energy policies. The disaster draws attention not just to what we do *after* a disaster strikes, but what we have done or not done *before* it does.

This chapter provides glimpses of how people experience and talk about climate change in India. What they say, combined with evidence from the scientific literature, increasingly indicates that its effects are already severely impacting lives and ecosystems. It is concerning that these are based on barely 0.8°C of average warming, since the science suggests we are at the beginning of a very long warming curve. How sharply that curve rises depends on development trajectories, energy choices, climate movements, and the urgency displayed by political elites, in India and elsewhere.

Some of the examples presented in this chapter interrogate the perception that the effects of climate change in India have been uniformly negative. Farmers in the higher reaches of the Himalayan states have partially benefited. So may have thousands of fishers with the spread of key marine species northwards by hundreds of kilometres, though its effects are complicated by simultaneous social changes, such as expanding capitalist practices in fishing and grave resource depletion. However, given continued climatic shifts, the durability of these gains is questionable.

The examples also suggest that those least responsible for climate change tend to be inordinately affected, such as marginal farmers in

the Sunderbans, labourers undergoing greater heat stress, or women facing acute water shortages in Himalayan villages. People who spend years trying to improve their lot are being pulled back down, as the limited gains from development get reversed by the effects of global warming. Any understanding of equity and climate justice needs to take account of the vulnerable within societies, and not only focus on an international, nation-state framework that tends to be divided between North and South.

Women in general, and underprivileged women in particular, constitute perhaps the largest social group in India affected by the combination of increased variability and climate change. It impacts many aspects of their lives and labour that women are made to perform within the home and outside—as construction workers, factory labour, and agricultural workers; in activities such as fetching water, and nurturing; and in terms of access to food and nutrition. A gendered perspective on climate change is sorely needed to be further developed in India.¹²

Also largely missing in India is the urgency which needs to inform human action everywhere if the planet is to avoid crossing thresholds into dangerous levels of average warming beyond 2°C, something that is now being viewed by some scientists as increasingly likely (Raftery et al. 2017).

Finally, the already grave impacts on other species—this chapter touches upon just one—generate a richer and more-nuanced understanding of the problem and underline the need for even greater urgency in tackling it. We humans are part of interconnected ecosystems and serious damage to any of their elements and interactions affects us all.

References

- Adusumalli, Malathi, Soumya Dutta, and Ajay Jha. 2013. *Climate Extremes and Loss and Damage: Lessons from the Uttarakhand Disaster, India*. Delhi: Beyond Copenhagen.
- Adve, Nagraj. 2014. 'Moving Home: Global Warming and Shifts in Species' Range in India', *Economic & Political Weekly*, 49(39): 34–8.

¹² A recent special issue of the *Economic & Political Weekly* goes some way in filling this gap (see Rao and Hans 2018).

- Centre for Science and Environment (CSE). 2017. 'Parched Hills of Uttarakhand', in R. Mahapatra, S.S. Jeevan, and S. Das (eds), *Environment Reader for Universities*, pp. 64–5. New Delhi: CSE.
- Chopra, Ravi. 2013. 'The Untold Story from Uttarakhand', *The Hindu*, 25 June. Available at <http://www.thehindu.com/opinion/lead/the-untold-story-from-uttarakhand/article4847166.ece>; accessed on 15 May 2019.
- Food and Agricultural Organization (FAO)/Foundation for Ecological Research, Advocacy and Learning (FERAL). 2008. *Co-management and Livelihood Enhancement Planning in Coastal Artisanal Fisheries*. Puducherry: FERAL.
- Ghosh, Nilanjan, Jayanta Bandyopadhyay, Anamitra Anurag Danda, and Sugata Hazra. 2016. *Away from the Devil and the Deep Blue Sea*. Delhi: WWF India.
- Gnanaseelan, C., M.K. Roxy, and A. Deshpande. 2017. 'Variability and Trends of Sea Surface Temperature and Circulation in the Indian Ocean', in M.N. Rajeevan and S. Nayak (eds), *Observed Climate Variability and Change over the Indian Region*, pp. 165–79. Singapore: Springer Geology.
- Hansen, James, Makiko Sato, Reto Ruedy, Gavin A. Schmidt, Ken Lo, and Avi Persin. 2019. 'Global Temperature in 2018 and Beyond'. Available at http://www.columbia.edu/~jeh1/mailings/2019/20190206_Temperature2018.pdf; accessed on 15 May 2019.
- Hazra, Sugata, Isha Das, Kaberi Samanta, and Tuhin Bhadra. 2014. *Impacts of Climate Change in Sunderban Area of West Bengal, India*. Kolkata: Jadavpur University.
- Hazra, Sugata, Tuhin Ghosh, Rajashree DasGupta, and Gautam Sen. 2002. 'Sea-Level and Associated Changes in the Sunderbans', *Science and Culture*, 68(9–12): 309–21. Available at <http://www.saconenvis.nic.in/publication%5CSea%20Level%20and%20associated%20changes%20in%20the%20Sundarbans.pdf>; accessed on 15 May 2019.
- Jodha, Vijay. 2005. *The Weeping Apple Tree*. UK Environment Film Fellowships. Film, at 9 mins 18 secs.
- National Snow and Ice Data Center. 2018. 'SOTC: Ice Sheets'. Available at https://nsidc.org/cryosphere/sotc/ice_sheets.html, accessed on 24 May 2018.
- Pai, D.S., P. Guhathakurta, A. Kulkarni, and M.N. Rajeevan. 2017. 'Variability of Meteorological Droughts over India', in M.N. Rajeevan and S. Nayak (eds), *Observed Climate Variability and Change over the Indian Region*, pp. 73–87. Singapore: Springer Geology.
- Payo, Andres, Anirban Mukhopadhyay, Sugata Hazra, Tuhin Ghosh, Subhajit Ghosh, Sally Brown, Robert J. Nicholls, Lucy Bricheno, Judith Wolf, Susan Kay, Attila N. Lazar, and Anisul Haque. 2016. 'Projected

- Changes in Area of the Sunderban Mangrove Forest in Bangladesh due to SLR by 2100', *Climatic Change*, 139(2): 279–91. Available at <https://doi.org/10.1007/s10584-016-1769-z>.
- People's Science Institute (PSI). 2010. *Documenting Climate Change in Uttarakhand*. Dehradun: PSI.
- Poloczanska, Elvira S., Christopher J. Brown, William J. Sydeman, Wolfgang Kiessling, David S. Schoeman, Pippa J. Moore, Keith Brander, John F. Bruno, Lauren B. Buckley, Michael T. Burrows et al. 2013. 'Global Imprint of Climate Change on Marine Life', *Nature Climate Change*, 3(August): 919–25. Available at <http://dx.doi.org/10.1038/NCLIMATE1958>.
- Public Advocacy Initiatives for Rights and Values in India (PAIRVI). 2010. *Jalvayu Sankat: Peediton ki Jubani*. Delhi: PAIRVI.
- Raftery, Adrian E., Alec Zimmer, Dargan M.W. Frierson, Richard Startz, and Peiran Liu. 2017. 'Less than 2°C of Warming by 2100 Unlikely', *Nature Climate Change*, 7(July): 1–5. Available at <http://dx.doi.org/10.1038/nclimate3352>.
- Rana, R.S., R.M. Bhagat, V. Kalia, H. Lal, and V. Sen. 2013. 'Indigenous Perceptions of Climate Change vis-à-vis Mountain Agricultural Activities in Himachal Pradesh, India', *Indian Journal of Traditional Knowledge*, 12(4): 596–604. Available at <http://www.hpccc.gov.in/PDF/Agriculture/Indigeneous%20Perceptions%20of%20Climate%20Change.pdf>; accessed on 15 May 2019.
- Rao, Nitya and Asha Hans. 2018. 'Review of Women's Studies: Gender and Climate Change', *Economic & Political Weekly*, 53(17). Available at <https://www.epw.in/journal/2018/17/review-womens-studies/gender-and-climate-change.html>.
- Rathore, L.S., S.D. Attri, and A.K. Jaswal. 2013. *State Level Climate Change Trends in India*. Delhi: Indian Meteorological Department. Available at <http://www.imd.gov.in/section/climate/StateLevelClimateChange/MonoFinal.pdf>; accessed on 10 August 2018.
- Ren, Yu-yu, Guo-yu Ren, Xiu Bao Sun, Arun B. Shrestha, Qing Long You, Yun Jian Zhan, Pan-Feng Zhang, Rupak Rajbhandari, and Kang-Min Wen. 2017. 'Observed Changes in Surface Air Temperature and Precipitation in the Hindu Kush Himalayan Region Over the Last 100-plus Years', *Advances in Climate Change Research*, 8 (3): 148–56. Available at <http://dx.doi.org/10.1016/j.accre.2017.08.001>.
- Rohini, P., M. Rajeevan, and A.K. Srivastava. 2016. 'On the Variability and Increasing Trends of Heat Waves over India', *Nature Scientific Reports*, 6(26153). Available at <http://dx.doi.org/10.1038/srep26153>.
- Roxy, M.K., S. Ghosh, A. Pathak, R. Athulya, M. Mujumdar, R. Murtugudde, Pascal Terray, and M. Rajeevan. 2017. 'A Threefold

- Rise in Widespread Extreme Rain Events over Central India', *Nature Communications*, 8(708): 1–11. Available at <https://doi.org/10.1038/s41467-017-00744-9>; accessed on 15 May 2019.
- Roxy, M.K., R. Kapoor, P. Terray, R. Murtugudde, K. Ashok, and B.N. Goswami. 2015. 'Drying of Indian Subcontinent by Rapid Indian Ocean Warming and a Weakening Land–Sea Thermal Gradient', *Nature Communications*, 6(June): 1–10. Available at <https://doi.org/10.1038/ncomms8423>; accessed on 15 May 2019.
- Schiermeier, Quirin. 2017. 'Artificial Warming Trial Reveals Striking Sea-floor Changes', *Nature*, 31 August. Available at <https://www.nature.com/news/artificial-warming-trial-reveals-striking-sea-floor-changes-1.22543>; accessed 24 May 2018.
- Shrestha, Mandira Singh, Wolfgang E. Grabs, and Vijay R. Khadgi. 2015. 'Establishment of a Regional Flood Information System in the Hindu Kush Himalayas: Challenges and Opportunities', *International Journal of Water Resources Development*, 31(2): 238–52. Available at <http://dx.doi.org/10.1080/07900627.2015.1023891>; accessed on 15 May 2019.
- Sikka, D.R., K. Ray, K. Chakravarthy, S.C. Bhan, and A. Tyagi. 2015. 'Heavy Rainfall in the Kedarnath Valley in June 2013', *Current Science*, 108(2): 353–61. Available at https://www.researchgate.net/publication/278021179_Heavy_Rainfall_in_Kedarnath_Valley_during_Advancing_Monsoon_Phase_in_June_2013; accessed on 15 May 2019.
- Singh, Deepti, Daniel E. Horton, Michael Tsiang, Matz Haugen, Moetasim Ashfaq, Dui Mei, Diksha Rastogi, Nathaniel C. Johnson, Allison Charland, Bala Rajaratnam et al. 2014. 'Severe Precipitation in Northern India in June 2013: Causes, Historical Context and Changes in Probability', *Bulletin of the American Meteorological Society*, 95(9): S58–61. Available at https://www.researchgate.net/publication/266554791_Severe_precipitation_in_northern_india_in_june_2013_causes_historical_context_and_changes_in_probability; accessed on 15 May 2019.
- Srivastava, A.K., D.R. Kothawale, and M.N. Rajeevan. 2017. 'Variability and Long-Term Changes in Surface Air Temperatures over the Indian Subcontinent', in M.N. Rajeevan and S. Nayak (eds), *Observed Climate Variability and Change over the Indian Region*, pp. 17–35. Singapore: Springer Geology.
- Vivekanandan, E. 2011. *Climate Change and Indian Marine Fisheries*. Kochi: Central Marine Fisheries Research Institute.
- Vivekanandan, Elayaperumal, Rudolf Hermes, and Chris O'Brien. 2016. 'Climate Change Effects in the Bay of Bengal Large Marine Ecosystem', *Environmental Development*, 17(September): 46–56. Available at <http://dx.doi.org/10.1016/j.envdev.2015.09.005>.

SECTION II

INTERNATIONAL DEBATES AND NEGOTIATIONS

Global Warming in an Unequal World*

A Case of Environmental Colonialism

Anil Agarwal and Sunita Narain

The idea that developing countries like India and China must share the blame for heating up the earth and destabilizing its climate, as espoused in a recent study published in the United States (US) by the World Resources Institute (WRI) in collaboration with the United Nations, is an excellent example of environmental colonialism.

The report of the WRI, a Washington-based private research group, is based less on science and more on politically motivated and mathematical jugglery (WRI 1990). Its main intention seems to be to blame developing countries for global warming and perpetuate the current global inequality in the use of the earth's environment and its resources.

A detailed look at the data presented by WRI itself leads to the conclusion that India and China cannot be held responsible even for

* Selected excerpts reprinted from Anil Agarwal and Sunita Narain. 1991. *Global Warming in an Unequal World: A Case of Environmental Colonialism*. New Delhi: Centre for Science and Environment. Reproduced with permission from the Centre for Science and Environment.

a single kg of carbon dioxide (CO₂) or methane that is accumulating in the earth's atmosphere. Carbon dioxide and methane are two of the most important gases contributing to global warming. The accumulation in the earth's atmosphere of these gases is mainly the result of the gargantuan consumption of the developed countries, particularly the US. ...

WRI's Calculations: Faulty and Prejudiced

The figures used by WRI to calculate the quantity of CO₂ and methane produced by each country are extremely questionable. Heavy emphasis has been placed on CO₂ production due to deforestation and methane production from rice fields and livestock, as compared to CO₂ production from the use of fossil fuels like oil and coal. Since developing countries are more responsible for the former, the heavy emphasis on deforestation and methane generation tends to overplay their contribution, while underplaying that of the developed countries.

Brazil, for instance, is a clear case where deforestation estimates have been overstated. Even though Brazil's deforestation did peak in 1987, several Brazilian sources point out that they have reduced substantially since then. Its CO₂ emissions since 1987, and on average during the 1980s, are much lower than those taken by WRI to calculate CO₂ emissions. Similarly, in India, deforestation rates do not seem to be the same as that of the 1970s, that is, 1.5 million hectares a year—the figure taken as the yearly average by WRI for the 1980s. ... For other developing countries also, the accuracy of the forest loss estimates used by WRI to calculate CO₂ levels are very shaky. ...

The fact remains that forest loss data in the world is still extremely poor and it is difficult to use it for any set of calculations of carbon emissions to the same level of precision as fossil fuel use data.

The methane issue raises further questions of justice and morality. Can we really equate the CO₂ contributions of gas-guzzling automobiles in Europe and North America or, for that matter, anywhere in the Third World with the methane emissions of draught cattle and rice fields of subsistence farmers in West Bengal or Thailand? Do these people not have a right to live? But no effort has been made in WRI's report to separate out the 'survival emissions' of the poor, from the 'luxury emissions' of

the rich. Just what kind of politics or morality is this which masquerades in the name of 'one worldism' and 'high minded internationalism'?

Centre for Science and Environment's (CSE) Calculations

The CSE's analysis presented in this report does not question the data that WRI has used to calculate each country's production of CO₂ and methane, even though, as argued above, they definitely can be questioned. Yet, CSE's analysis shows India and China cannot be blamed for any of the methane or CO₂ that is appearing in the atmosphere.

As a senior United Nations Environment Programme (UNEP) official has put it, nature serves two major economic functions—one, as a source of raw materials and, two, as a sink for absorbing wastes (Ahmad 1990).

Ideally, the approach should have been to prepare each nation's budget of greenhouse gas (GHG) emissions by taking into account each nation's sources of emissions and its terrestrial sinks, that is, its forests, other vegetation, and soils. This exercise would have given an idea of the true emissions of each nation. These emissions would have to be further matched with each nation's just and fair share of the oceanic and tropospheric sinks—a common heritage of humankind. Only then the net emissions of a nation that are accumulating in the atmosphere could be calculated. But nothing of this sort has been attempted by WRI.

The earth's environment has a considerable ability to absorb wastes. The ocean is an important sink for absorbing CO₂ produced through human activity. According to the estimates of the Intergovernmental Panel on Climate Change, the ocean absorbed, during the 1980s, CO₂ to the tune of 1,200–2,800 million tonnes of carbon equivalent every year. There could also be terrestrial sinks for CO₂ but scientific knowledge about them is still uncertain. The various models prepared world-wide for estimating the accumulation of CO₂ in the atmosphere reveal a substantial 'missing sink', which scientists now believe could be a terrestrial sink. The predicted amount of CO₂ increase in the atmosphere should be ideally equal to the amount of CO₂ emitted by human-made sources less the amount absorbed by the oceanic sinks. But models find that instead

the predicted amount is more than what is actually accumulating in the atmosphere, indicating the presence of yet another cleansing mechanism in the world. There is a growing belief that various land processes like vegetation and soil could possibly account for this surplus. Some preliminary models even suggest that these terrestrial sinks could be possibly even larger than the oceanic sinks. But much of this is still unknown.

Sink for methane is primarily removed by a reaction with hydroxyl radicals (OH) in the troposphere. This reaction represents a sink of about 400–600 million tonnes per year. Soils may also be contributing in removing methane to the tune of 15–54 million tonnes each year (Figure 5.1).

The WRI's legerdemain actually lies in the manner that the earth's ability to clean up the two GHGs of CO₂ and methane—a global common of extreme importance—has been unfairly allocated to different countries. According to WRI figures, the world produces every year 31,100 million tonnes of CO₂ and 255 million tonnes of methane. But in reality, the increase in the atmosphere every year is only 13,600 million tonnes of CO₂ and 43 million tonnes of methane. In other words, the earth's ecological systems—its vegetation and its oceans—absorb 17,500 million tonnes of CO₂ and 212 million tonnes of methane every year. Global warming is caused by over exceeding this cleansing capacity of the earth's ecological systems. The WRI report makes no distinction between those countries which have eaten up this ecological capital by exceeding the world's absorptive capacity and those countries which have emitted gases well within the world's cleansing capacity. India, for instance, has been ranked as the fifth-largest contributor of GHGs in the world.

But compared to its population—16.2 per cent of the world's in 1990—India's total production of CO₂ and methane amounted to only six per cent and 14.4 per cent, respectively, of the amount that is absorbed by the earth's ecological systems. How can, therefore, India and other such countries be blamed even for single kg of the filth that is accumulating in the atmosphere on a global scale and threatening the world's people with a climatic cataclysm? In fact, India can double its total CO₂ emissions without threatening the world's climate. And if it controls its deforestation, then it can increase its CO₂ emissions from fossil fuels several times.

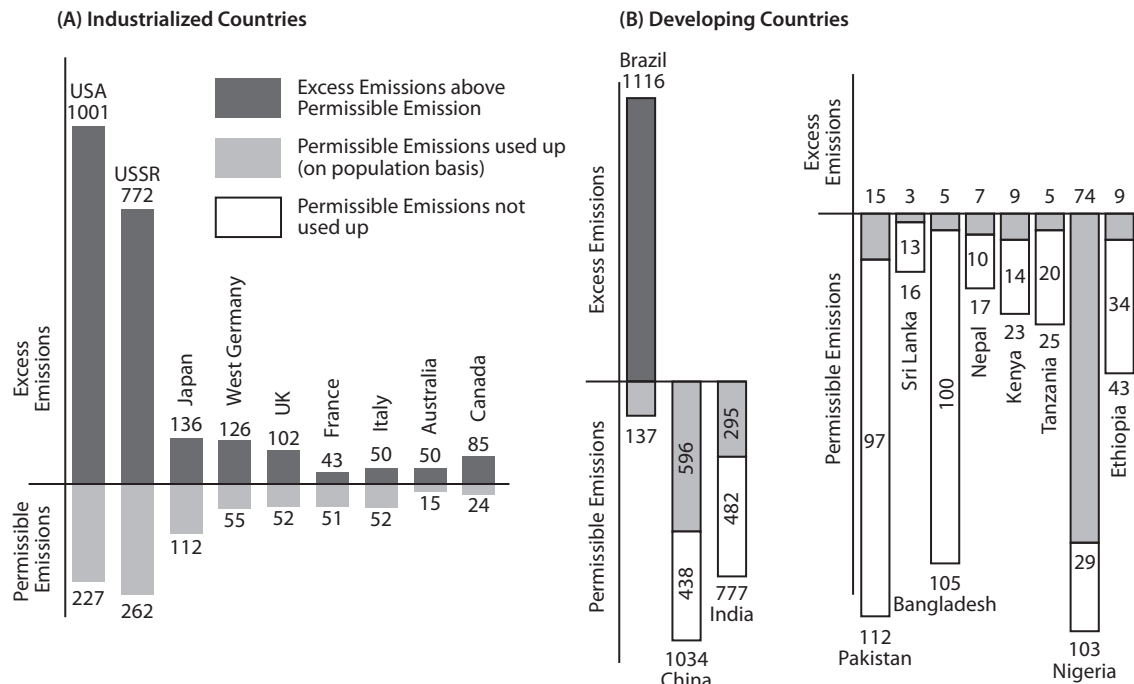


Figure 5.1 Permissible Emissions versus Total Emissions of CO₂ of Select Countries on the Basis of Population (in million tonnes of carbon equivalent) as Calculated by CSE

Note: This is Figure 2 in original text.

Source: Authors.

On the contrary, the US, with only 4.73 per cent of the world's population, emits as much as 26 per cent of the CO₂ and 20 per cent of the methane that is absorbed every year. It is the production of CO₂ and methane by countries like the US and Japan—totally out of proportion to their populations and that of the world's absorptive capacity—which is entirely responsible for the accumulation of unabsorbed CO₂ and methane in the atmosphere. In addition, these countries emit large quantities of chlorofluorocarbons (CFCs)—chemicals which do not get absorbed at all. Japan accounts for 7.4 per cent and the US for 25.8 per cent of the world's consumption of CFCs.

Not even one tonne of CFCs released into the atmosphere can get absorbed because there is no natural sink for them. As concerned environmentalists, we should propose that no country should be 'allowed' to produce such chemicals which the atmosphere has no ability to cleanse naturally, and all production of such chemicals should be added to the net emissions of the individual countries.

But the WRI report does not take countries like the US or Japan to task. On the contrary, it adopts a mathematical technique which puts the blame on several poor countries. The WRI has calculated the proportion of the world's GHGs produced by a country like India and has then used this proportion to calculate India's share in the quantity of gases that are accumulating in the atmosphere. ...

Sharing a Crucial Global Common

How can we calculate each country's share of responsibility for the accumulation of gases like CO₂ and methane in the earth's atmosphere?

It is obvious that the concept of sustainable development demands that human beings collectively do not produce more CO₂ and methane than the earth's environment can absorb. The question is how should this global common—the global CO₂ and methane sinks—be shared amongst the people of the world?

Several studies on the global warming problem have argued, and we argue ourselves, that in a world that aspires to such lofty ideals like global justice, equity, and sustainability, this vital global common should be shared equally on a per capita basis.

Using this principle, CSE has adopted the following methodology to ascertain the net emissions which are posing a threat to the world's climate (Figure 5.2):

1. The natural sinks for CO₂ and methane have been allocated to each nation on a population basis. These quantities then constitute the permissible emissions of each country. As no natural sinks exist for CFCs, no permissible shares for CFCs have been calculated.
2. The total emissions of each country of CO₂ and methane (as calculated by WRI) have then been compared with its permissible emissions (as calculated by CSE) to ascertain the quantity of emissions that are in excess of the permissible emissions.
3. The unused permissible emissions of countries like India and China have been traded with the excess emitters on a population basis.
4. The permissible emissions, traded from low-emitting countries, have been subtracted from the excess emissions of each country to obtain the quantity of each country's net emissions to the atmosphere of CO₂ and methane.
5. The total GHG emissions have been obtained by adding the net emissions of methane and CO₂ (as obtained by CSE) with the total emissions of CFCs (as given by WRI).

The CSE's calculations clearly show that there is one set of nations in the world which is emitting GHGs well within its share (or, in other words, its permissible limits), whereas there is another set of countries which is exceeding its permissible limits by leaps and bounds (Figure 5.3). ...

Lack of Third World Research

The entire episode also emphasizes the fact that Third World nations must undertake their own research in this crucial area. They cannot depend on Western institutions to present a true picture of the global situation and safeguard their interests. The manner in which the methane and CO₂ emissions of several developing countries have been calculated is itself open to questions. The database on

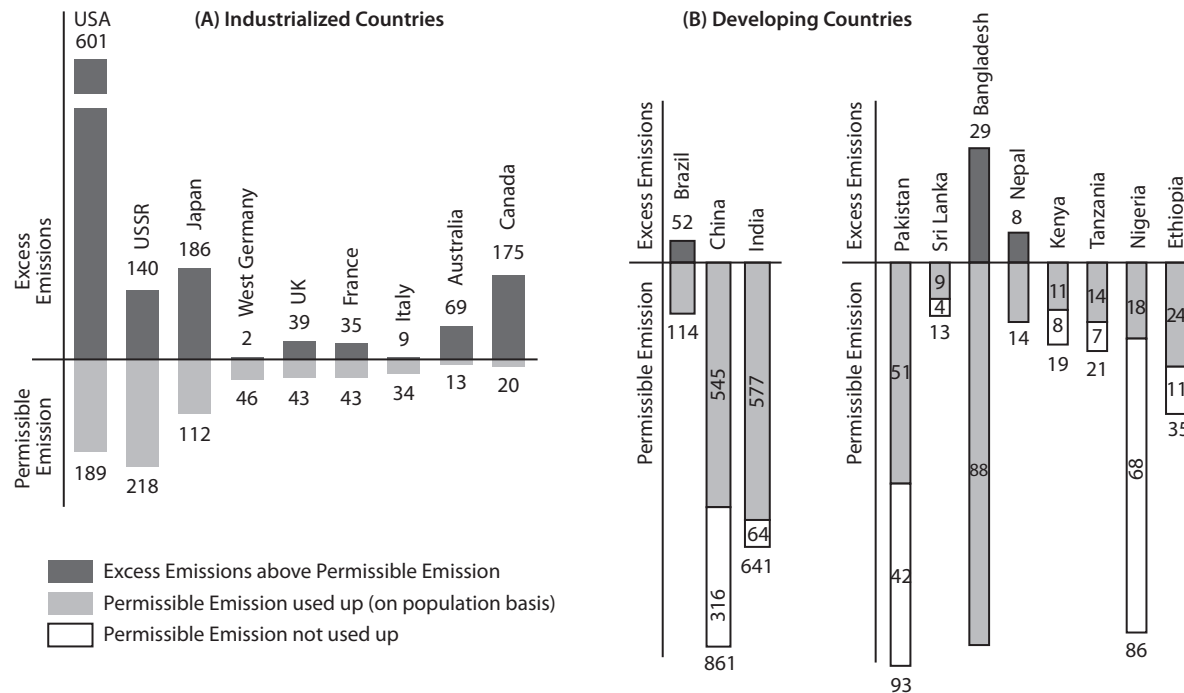


Figure 5.2 Permissible Emissions versus Total Emissions of Methane of Select Countries on the Basis of Population (in million tonnes of carbon equivalent) as Calculated by CSE

Note: This is Figure 3 in original text.

Source: Authors.

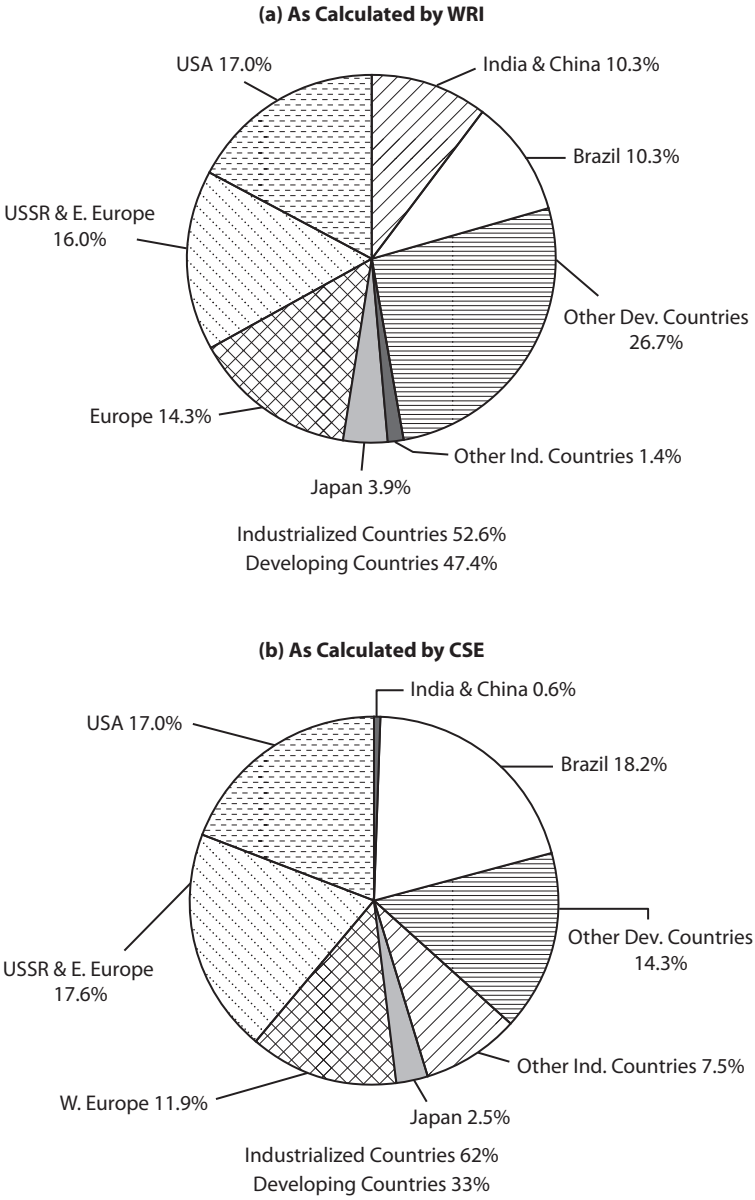


Figure 5.3 Percentage Distribution of Net Emissions of GHGs by Industrialized and Developing Countries
Note: This is Figure 5 in original text.
Source: Authors.

contributions from deforestation, irrigated rice farming, and livestock management is still poor. It is vital that a reliable system of measuring deforestation annually on a global and national basis is developed urgently. ...

Action in India

None of this means that India should not regenerate its environment or that it should not be efficient in its use of energy. This will also be our best defense against any possible impact of global warming. As only if the diverse ecosystems of India are functioning at the optimum levels of productivity, the effects of the expected changes in the global climate will become somewhat manageable. But if, as today, our land and water resource base remains highly stressed and degraded and even normal conditions constitute a near-crisis situation, climatic perturbations will throw the society into a state of total emergency.

But to carry out this strategy to improve land productivity and meet people's survival needs, development strategies will have to be ecosystem specific and holistic. It would be necessary to plan for each component of the village ecosystem and not just trees—from grasslands, forest lands, and crop lands to water. To do this, the country will need much more than just glib words about people's participation or wasteland development. It will demand bold and imaginative steps to strengthen and deepen local democracy by creating and empowering democratic and open village institutions. Only then will the people get involved in managing their environment. It will mean dismantling the inefficient and oppressive government apparatus and changing laws so that people can act without waiting for a good bureaucrat to come along. As laws exist, planting trees on government wastelands can land villagers in jail. The government is the biggest and the worst land and water owner in the country.

Those who talk about global warming should concentrate on what ought to be done at home. The challenge for India is thus to get on with the job at hand, and leave the business of dirty tricks and dirtying up the world to others. In this process, we will help ourselves, and maybe even the rest of the world.

References

- Ahmad, Yusuf J. 1990. 'Energy Issues in Environmental Economics', Paper presented at a Seminar on Economics of the Sustainable Use of Forest Resources, April 1990, Centre for Science and Environment, New Delhi.
- World Resources Institute (WRI). 1990. *World Resources 1990–91: A Guide to the Global Environment*. New York: Oxford University Press.

Equity in Long-Term Mitigation

Tejal Kanitkar and T. Jayaraman

Despite the passage of more than 20 years since the United Nations Framework Convention on Climate Change (UNFCCC) came into existence in 1992, the adequacy of climate action in terms of both mitigation and adaptation remains a matter of profound concern across most sections of global public opinion.

The complex, if not tortuous, path that global climate negotiations have taken to arrive even at the Paris Agreement in 2015 is testimony to the considerable difficulties that attend the process of coordinated action at the global scale to deal with the various dimensions of climate action. It is well known that there are significant fault lines between different nations or groups of nations on contentious issues at the global negotiations. While the broad divide between developed and developing nations continues to exist, numerous other fault lines have appeared between nations that have begun, in part, to overshadow this older division. There are a number of issues which characterize these fault lines, but it is equity in long-term mitigation action, an issue that goes back to the origins of the global climate discourse, that will be the subject of this chapter. While this issue was originally framed almost wholly within the developed versus

developing framework, it has, perhaps unsurprisingly, continued to be one of the key contentious issues.

What do we mean by equity? For the purposes of this chapter, we shall take a pragmatic view of the concept and treat it as equivalent to the term fairness and consider it to be the equivalent in environmental governance of what is implied by the term justice in a more philosophical language (Schroeder and Pisupati 2010). This is, of course, somewhat of an oversimplification and there are subtle differences between the concepts of justice, fairness, and equity, which we shall not have cause to pursue in detail in the rest of the chapter (see Konow 2003, for a more detailed discussion). More relevant to our discussion is the fact that equity can encompass a range of ideas, drawn from a number of varying approaches to the concept. Equity may relate to equity of outcomes of a particular policy or a governance regime. Equity of processes by which a policy or a regime is arrived at is another consideration. Equity may involve redistributive justice to correct historical wrongs suffered by communities, groups, societies, or countries. It is also important to note that equity may refer to fairness between individuals, between communities or groups, or nations. Equity may also refer simply to fairness between individuals without reference to their location in communities or nations. In some perspectives, markets are inherently dis-equalizing, and hence equity requires that the unregulated functioning of markets should not be permitted. All these varying notions of equity, which by no means exhaust the entire range of possible meanings attached to equity, in fact do make their appearance in some fashion in the global climate discourse.

Equity and the Global Climate Regime

Within the narrower scope of climate action in the framework of the UNFCCC, considerations of equity in climate change typically begin from the interpretation of Article 3.1 of the UNFCCC that states: ‘The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities’ (UNFCCC 1992). Article 3.1, in fact, follows immediately on Article 2 that states the ‘ultimate objective’

of the Convention, namely, the ‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system’ (UNFCCC 1992). Since the primary means of protecting the climate system for present and future generations is through the drastic slowing down and eventual cessation of greenhouse gas (GHG) emissions of anthropogenic origin, considerations of equity in climate change have typically focused on mitigation and the manner in which different nations are to share the global responsibility enjoined in Article 2. Alongside equity, Article 3.1 also states clearly the principle of ‘common but differentiated responsibilities and respective capabilities’ (CBDR&RC) in protecting the climate system, and one of the key issues in considerations of equity in relation to climate change is the relationship between equity and the CBDR&RC principle.

The import of the last sentence in the statement of Article 3.1 that ‘developed country Parties should take the lead in combating climate change and the adverse effects thereof’ is clearly the recognition that global inequalities between nations demand that greater responsibility lies with the developed countries. Though sometimes not recognized as such, it is evident that this statement is an equity principle, and one that was the first to be articulated in practice as we shall discuss shortly. The demand for greater climate action from the developed countries is discussed further in Articles 4.3 and 4.5, which detail the commitments of the developed countries listed in Annex II to assist the developing countries in climate action, including the provision of finance for climate action and technology transfer. Article 4.8 further recognizes the specialized needs of some nations due to the response measures to combat global warming.

The UNFCCC itself clearly recognizes that equity in climate change cannot be limited to mitigation alone. Equity concerns are associated with adaptation as well. Many countries and communities that are poor are recognized as being particularly vulnerable to climate change (Smit and Pilifosova 2003; Smith et al. 2009). Equity issues arise in other aspects of adaptation, including adaptation finance (Ayers and Huq 2009; Denton 2010). Article 4.4 as well as Article 4.8, just referred to, specifically recognize the adaptation needs of vulnerable countries, with the latter outlining the vulnerable settings in some detail, while the equity aspect of adaptation is

specifically recognized in Article 4.4 through the responsibility of the developed countries to assist the developing ones in adaptation. To sum up, it is clear that the very need for global action in a very unequal world would immediately raise the issue of equity.

The crux of the problem of equity post the ratification of the UNFCCC was therefore not quite the recognition of the need for equity in climate action, but the manner in which this need was to be articulated in detail and operationalized, especially with regard to long-term mitigation goals. While the Convention is seemingly a stirring document for unity of action, the operationalizing of equity brings to the fore immediately all the ambiguities that are present in the language of the Convention. This is a more general problem with equity in other contexts too, that operationalization is not easy even if the broad principles are clear. As Konow (2000: 1073) notes: 'Agreement on principles of fairness, however, does not rule out substantial disparity in claims based on those principles. In addition, the difficulty, perhaps even impossibility, of simple solutions to injustice does not preclude the existence of simple principles of justice.'

Even prior to specific means of implementing fairness in practice, one of the first fault lines that immediately emerges in the context of operationalizing equity is the tension in Article 3.1 between the term 'on the basis of equity' and the CBDR&RC principle that immediately follows it. Given the specificity of the latter, and the construction of the sentence, to many commentators it has seemed that the latter is simply the explication of the former, and therefore specifying the means to operationalize equity (Metz 2000; Ringius, Torvanger, and Underdal 2002). To others though, it has equally seemed that since the CBDR&RC is capable of being operationalized in a very large number of ways, equity should be the basis of selecting from among all approaches that satisfy the former. Thus, 'on the basis of equity' states an independent principle apart from CBDR&RC (Cazorla and Toman 2001; Pan, Teng, and Wang 2014). Over time, various approaches to equity have been suggested that cover the entire range of possibilities, from operationalizing equity in a way that automatically ensures CBDR&RC to the other, where the latter is seen as explicating the former and so effectively only the latter is taken implemented.

The first attempt at operationalizing equity was in the formulation of the Kyoto Protocol (KP), where the key equity principle was simply the differentiation between developed and developing country parties (UNFCCC 1997). Notwithstanding the enthusiasm for the KP in many developing countries for several years until the Paris Agreement, it was clear that the KP was seriously deficient in important ways. One was that the broad differentiation of Annex I and non-Annex I parties adopted in the KP clubbed many large emerging economies alongside the least developed countries in the non-Annex I category, and was unlikely to work in the long term. Furthermore, the non-Annex I parties were not required to take any action (except emissions reduction through carbon trading), while the Annex I parties had fixed targets, which soon became clear was untenable. Efforts to find more nuanced ways of differentiation of countries and regions were almost immediately undertaken, and although the Annex I versus non-Annex I classification continued to hold in the formal negotiations, different axes of classification had already started emerging in the literature. While the impact of these discussions was seen in the formal negotiations, with developing countries agreeing to undertake voluntary mitigation action in Bali, at the 15th Conference of the Parties (COP 15) in Copenhagen, the first signs of the breakdown of the KP and the emergence of a new mitigation regime became evident. The second and more important problem was that climate science was making it increasingly definite that the KP in its existing form would be highly inadequate, given the quantum of emissions reductions required to limit temperature rise, especially for long-term mitigation. In any case, the KP did not even have a long-term mitigation goal.

Since then, the focus of the equity debate in the climate discourse has decisively shifted to the problem of how the global long-term mitigation goal was to be broken down to the long-term mitigation goals of individual nations. This will be the subject of the rest of this chapter, even though, as we have already noted, this by no means exhausts the question of equity in climate action.

Operationalizing Equity in Long-Term Mitigation Goals

The many different approaches to operationalizing equity can be broadly classified by two criteria: (i) what is to be divided in terms

of the framing of the global mitigation target; and (ii) how is it to be divided in terms of the mitigation responsibility for different regions or countries.

The Global Mitigation Target—What Is to Be Divided?

Two broad categories of approaches to the definition of the global mitigation target can be identified as: the ‘resource-sharing approach’ and the ‘effort-sharing approach’ (Baer, Athanasiou, and Kartha 2007). The resource-sharing approach basically argues that the atmosphere is a sink for GHG (dominantly carbon, of course) emissions, and that this constitutes an economic resource, since it enabled in the past and enables in the present and future the use of fossil fuel-based technologies that are typically cheaper than non-fossil fuel-based ones in the transition to a carbon-free world. This argument has been further strengthened with the identification by climate science of a definite carbon budget for the world, determining the total capacity of the atmosphere as a carbon sink corresponding to a particular limit on temperature rise (Intergovernmental Panel on Climate Change [IPCC] 2013).¹ It is this carbon budget which is to be divided among regions and/or countries based on a variety of parameters. There is a choice to be made here: whether the carbon budget should refer to only the currently remaining capacity to absorb emissions (the past having been written off); or whether it should include the capacity to absorb emissions from the period of the beginning of the Industrial Revolution, when anthropogenic emissions became truly substantial.

The effort-sharing approach, on the other hand, estimates the total burden of mitigation as the difference between a baseline trajectory of emissions growth that would have taken place without mitigation and a stabilization trajectory of emissions, that is, an emissions trajectory that would ensure that temperature rise stays below a predetermined limit. Unlike the carbon space used in the first category of approaches, what is divided among countries and/or regions in these

¹ For an account of the scientific advance on the carbon budgets approach and its application to climate policy, see Kanitkar et al. (2013) and the references therein.

effort-sharing approaches is the mitigation burden, defined as the difference between these two trajectories—baseline and stabilization. Figure 6.1 provides an illustration of the basic difference between the two sets of approaches.

The area under the curve labelled ‘Global Stabilization Trajectory’ represents the global carbon space between 2016 and 2050. On the other hand, the area between the two curves labelled ‘Global Baseline Trajectory’ and ‘Global Stabilization Trajectory’ represents the global mitigation burden between 2016 and 2050. In the resource-sharing approaches, the global carbon space is divided among regions and countries, referring to the emissions that are allowed for each one in the future. In the effort-sharing approaches, the carbon space, indicated as the space between the two curves, is divided among regions and countries using different parameters, referring of course to the emissions reduction that each one has to undertake. In the resource-sharing approach, past emissions can be brought into the picture as an integral part of what is to be shared. On the other hand, in the effort-sharing approach, past emissions have to be included as an external selection parameter in determining what share of the burden is due to each country or region.

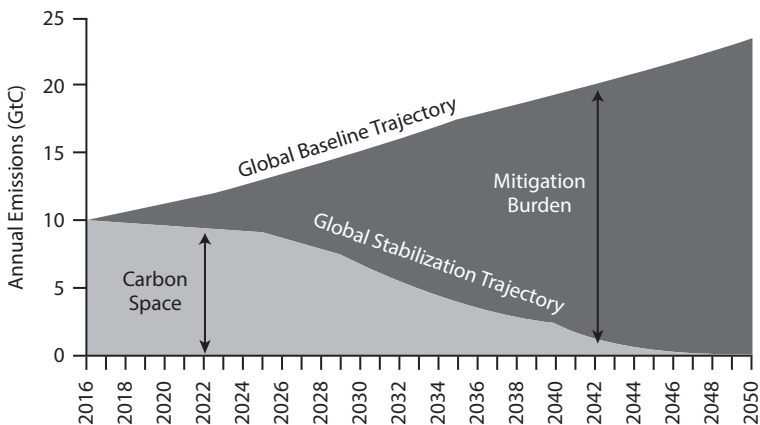


Figure 6.1 What Is to Be Divided?—Difference between Carbon Budgets (Resource Sharing) and Mitigation Burden (Effort Sharing)

Source: This figure has been created by the authors using dummy data purely for illustrative purposes.

Elementary as these sound, these two options represent the dominant approaches to equity in long-term mitigation targets. A number of developing countries as well as a wide range of global civil society and academic voices have indicated, in various ways, a preference for one or the other of these two approaches.

However, neither of these approaches to long-term mitigation goals have been popular among the developed countries. Instead, it is argued that the emission flows (typically estimated annually) from individual nations must all decrease and converge to a predetermined value by a certain period, with some leeway for developing countries perhaps to reach this value somewhat later in time (Meyer 1999). Here, the 'equity' principle is the equality of emission flows among the various parties, though this has been severely contested by proponents of the other two approaches. With the notion of the carbon budget having been established scientifically, this alternate approach has had to also determine the rate of decline of emissions and the value at which they would converge within the limits set by the carbon budget. This approach illustrates most sharply the tension over whether the CBDR&RC principle is tantamount to simply operationalizing equity, since it can be quite obviously argued that this approach fulfils the CBDR&RC principle, while obviously violating any commonsensical notion of equity.

Distributing the Mitigation Target—How Is the Target to Be Divided between Regions?

Once the global mitigation target is estimated, either in the form of carbon space or in the form of a mitigation burden, the next step is to divide this quantum of space or burden among different countries and/or regions. The difference between the starting points in the resource and burden-sharing schemes, discussed earlier, necessarily means that the range of parameters or indicators available for further distribution in both these approaches are different. In the resource-sharing or carbon space approach, it is the available resource that is being distributed. The simplest method available for the purpose of distribution of carbon space is a straightforward distribution based on a selected parameter, for example, distribution among countries on a per capita basis, that is, the share of each country's population.

In the effort-sharing approach, it is the notional deviation from a baseline trajectory constructed for the future that is to be estimated and then distributed. A per capita division of the mitigation burden in this case will have to be applied differently, that is, with a reversed logic, since concerns of equity would dictate that a higher population should not translate to a higher share of the mitigation burden.

The per capita basis for distributing the mitigation target, however this may be defined, has been an enduring feature of equity proposals. At the level of parties in the negotiations, this has been most consistently argued by India. One notable feature of the per capita argument is, of course, that it takes into account both global equity and international equity in one single parameter. On the other hand, this has been contested by Annex I parties, and even by developing countries such as Brazil, who have argued for past cumulative emissions and their consequent contribution to temperature increase, without however allowing allocation to be made on a per capita basis. The other basis of differentiation that also forms part of many equity proposals from developing countries is past cumulative emissions. Developing countries have consistently argued that the very notion of differentiation in the UNFCCC is in some sense based on this 'historical responsibility'. However, developed countries have also been insistent that this principle is entirely inadmissible.

Some Specific Proposals to Operationalize Equity

A number of specific ways to operationalize equity have been proposed that fall within these broad classifications, using different definitions of mitigation targets as well as different parameters for their distribution among different countries or regions. Some of the more prominent and well-known ones are summarized in Table 6.1.

Next, we will examine briefly one proposal from each category to illustrate the difference in perspectives.

Convergence-Based Approaches: The Contraction and Convergence Approach

The Contraction and Convergence (C&C) approach—reducing emission flows from each country to an equal level over time—was indeed one of the earliest proposals, though the initial emphasis was

Table 6.1 Approaches to Mitigation: Overview of Some Typical Proposals

	Proposals/Approaches	Base Year	Parameters for Differentiation	Logic
Convergence-Based Approaches	C&C (Meyer 1999)	1990	Current per capita emission flows.	No historical responsibility, convergence of per capita emissions from current levels to levels of population shares in 2050.
	CDC (Höhne, den Elzen, and Weiss 2006)	1990	Historical per capita emission flows.	Convergence of per capita emissions from current levels to levels of population shares in 2050, with delayed action for developing countries taking into account historical responsibility.
Effort- Sharing Proposals	GDR Framework (Baer, Athanasiou, and Kartha 2007; Kartha and Dooley 2016)	1990	Per capita GDP, per capita emission flows, development threshold—level of per capita GDP below which emissions are exempt from mitigation.	Per capita GDP and per capita emissions flow-based index to determine share of global mitigation burden; baseline trajectory constructed for each country assuming no climate action.
	CERF (Holz, Kartha, and Athanasiou 2018)	1850–1990	Per capita GDP, per capita cumulative emissions, HDI, development threshold.	Per capita GDP and per capita cumulative emissions-based index to determine share of global mitigation burden; baseline trajectory constructed for each country assuming no climate action.

(cont'd)

Table 6.1 (cont'd)

	Proposals/Approaches	Base Year	Parameters for Differentiation	Logic
	Climate Action Tracker (2015)	1990	Adequacy decided based on multiple equity proposals sourced from other literature.	Tracks adequacy of country-wise pledges by assessing their adequacy in comparison with 'fair trajectory' based on burden-sharing criteria.
Resource-Sharing Proposals	WBGU (2009)	1990, 2010	Per capita entitlement of carbon space.	Emission rates as per entitlements and trade.
	CASS (Jiahua and Ying 2009)	1850, 1970	Per capita entitlement of carbon budget.	Financial transfers for carbon debt.
	TISS–DSF (Jayaraman, Kanitkar, and D'Souza 2011; Kanitkar et al. 2010, 2013)	1850, 1900, 1970	Per capita entitlement of carbon budget (GDP, HDI weighting in later versions).	Progressive allocation of carbon space based on past and present responsibility.

Notes: 1. The approaches are as follows—C&C: Contraction and Convergence; CDC: Contract and Differential Convergence; GDR: Greenhouse Development Rights; CERF: Climate Equity Reference Framework; WBGU: German Advisory Council on Climate Change; CASS: Chinese Academy of Social Science; TISS: Tata Institute of Social Sciences; and DSF: Delhi Science Forum.

2. GDP: gross domestic product; HDI: human development index.

Source: Prepared by the authors by classifying various papers based on the approaches they take.

on speeding up mitigation action, rather than any considerations of equity, on the argument that all countries must start reducing emissions right away. The equity principle was more explicitly recognized in the modified Contract and Differential Convergence (CDC), where differentiation is allowed more explicitly, even allowing developing countries to briefly increase emissions before emissions reduction begins. In both variants, the annual per capita emission flows of both developed and developing countries converge to a predetermined value by a target year. In Meyer (1999), this predetermined value is that of their population shares by a target year.

A particular version of the C&C approach relevant to India is the rather grandiosely labelled Manmohan Singh Convergence Principle that refers to the offer made by India's then prime minister in 2007 at the Heiligendamm G8 Summit that India's per capita annual emissions would never exceed the per capita annual emissions of developed countries (Ministry of External Affairs 2007). This has not, however, been pursued by India in practice subsequent to COP 15.

These sets of proposals focus exclusively on annual emission flows and do not consider cumulative emissions or emissions stocks in their calculations of mitigation targets for individual countries. These proposals are often thought of as uncomplicated, and therefore easy to implement as well as monitor. However, there are two fundamental drawbacks of such a flow-based formulation from the equity standpoint of most other proposals. The first is that they 'grandfather' past emissions and only consider future emission flows, in the process disproportionately penalizing developing countries. The second is that the exclusive focus on flows and the lack of acknowledgement of the implied cumulative emissions that each flow trajectory represents, violates principles of equity by allowing developed countries to capture more carbon space even in the future.

Effort-Sharing Proposals: The Climate Equity Reference Framework

The Climate Equity Reference Framework (CERF) is currently one of the popular approaches in the literature to achieve equity, especially in academia and civil society. It was advocated initially

as an approach that can potentially include both elements of the CBDR&RC principle, that is, responsibility and capability (Baer, Athanasiou, and Kartha 2007; Kartha and Dooley 2016). In the more recent versions (Holz, Kartha, and Athanasiou 2018), historical cumulative emissions have been included as one of the potential measures of responsibility. In this proposal, typically the CBDR&RC is seen as the operational guideline for equity.

In this typical effort-sharing approach, the baseline scenarios have been constructed using variants of integrated assessment models that produce projections of economic growth, energy use, and corresponding emissions using a large number of exogenous and endogenous variables. Several such models have been constructed and several scenarios have been investigated (see, for instance, Nakicenovic et al. 2000). In most of these models, the global scenario is built from bottom-up considerations based on the globe divided into several regions, with the regions being linked through trade and investments. The emissions trajectory which must be reached through mitigation action was earlier (in the period before the IPCC *Fifth Assessment Report* [AR5]) based on some stabilization trajectory chosen from a range of possible trajectories referenced in the IPCC. In the more recent literature, authors underline that their chosen ‘stabilization pathways’ are consistent with AR5 results. This means that the trajectory chosen, say, a ‘66% probability—2°C trajectory’, should be compatible with a corresponding value of cumulative emissions allowed between, say, 2016 and 2100. The difference between the baseline trajectory and the stabilization trajectory chosen is then the global mitigation burden.

Having defined the global burden, the next task is to distribute this burden among different countries and regions. This step varies widely across different proposals. Among these proposals, the one which does the most justice to the equity principle is the CERF. In this approach, equity is ensured by the process of assigning for every country a certain amount of emission rights automatically, in proportion to the number of people below the poverty line. The CBDR&RC is implemented through the provision of sharing the remainder of the shift (after the poverty-based emissions rights for all countries is implemented) from the business-as-usual to the target trajectory, by a formula that accounts for both the responsibility

aspect (based on cumulative emissions from a certain base year) and the aspect of capability (that is based on per capita gross domestic product [GDP]).

The CERF approach and some of its variants are often considered as advantageous for three reasons. First, it explicitly acknowledges both responsibility and capability indicators, thus including the full scope of the principle of CBDR&RC in its analysis. Second, while it uses cumulative historical emissions as an indicator of responsibility, the actual calculation of mitigation burdens is emissions flow based, which is claimed to make the approach amenable to a periodic review process to monitor and verify progress on mitigation. Third, it completely avoids any narrative of 'entitlements', except for the poverty factor, which may make it a politically easier option around which consensus may be built. The Climate Equity Reference Calculator (CERC)² provides a tool for interactive use based on various assumptions that can be used to demonstrate the application of the CERF.

We put forward criticisms of the approach in two categories. First, the mitigation burden that is calculated is primarily determined by the global stabilization trajectory chosen and the baseline trajectories constructed for each country/region. The chosen simulation is only one among many possible stabilization trajectories that obey the limit of total allowable cumulative emissions for the future. The baseline trajectory, on the other hand, is essentially a counterfactual; and especially for developing countries, with dynamically changing economic structures and policies, such baselines for the long term are fraught with uncertainty. Thus, the particular choices of trajectories have serious consequences for how the mitigation burden is distributed across parties.

The second problem with this approach is that the mitigation burden for each region, which is essentially a share of the global mitigation burden, is progressively calculated. This implies that any growth leading to substantial increase in per capita GDP for a country would lead to an increase in its share of the mitigation burden. In the perspective of the resource-sharing approach, this progressive estimation of the burden implies that with economic growth, the

² Available at <https://calculator.climateequityreference.org/>.

share of the carbon space allocated to a country would progressively decrease, and typically successful poverty alleviation would result in the penalty of a higher mitigation burden. Thus, the approach progressively undermines its own stated principle of historical responsibility, leading to potentially significant negative consequences for large emerging economies in particular.

Resource-Sharing Proposals: The Carbon Budget Approach

The carbon budget approach, though originally proposed very early on, has been considerably sharpened more recently. Going beyond the first significant versions of more recent times, with specific quantitative estimates, the approach has attracted attention from others, especially climate scientists, since cumulative emissions became the preferred mode (in the *Fifth Assessment Report* of the IPCC) of calculating the maximum allowed emissions for keeping global warming below a specified temperature increase (of course, keeping in mind the uncertainties involved). At the same time, the approach attracts much political pushback, including on one occasion from the Secretary-General of the UNFCCC whose rejection of the approach was based on the assumption that the approach would be politically infeasible to implement (Harvey 2013).

There is significant scientific literature now, providing a range of estimates for the allowed cumulative GHG emissions into the future and the quantum of the cumulative emissions that have occurred since the last quarter of the nineteenth century, according to the temperature increase target that is specified (IPCC 2013; Rogelj et al. 2016; Tokarska and Gillet 2018). The carbon budget approach to sharing the global mitigation target has been explicated in other publications by the authors of this chapter, and has also been discussed in other proposals in this category (Jiahua and Ying 2009; Kanitkar et al. 2010, 2013). In this approach, the distribution of cumulative emissions, whether taking account of the past or not, depends upon an upfront calculation based on entitlements. The basis for such entitlements is of course a matter of negotiation, and different proposals may use varying assumptions and parameters.

In some variants of the carbon budget approach, there is a straightforward entitlement to cumulative emissions for countries based on

the per capita principle (this requires a choice of base year for determining the population), from which it emerges that developed countries have far overdrawn their 'fair share' and owe the world a carbon debt, while developing countries face a deficit in the gap between the cumulative emissions possible and their 'fair share'. However, such proposals reach a dead end unless a possible way of dealing with the carbon debt is outlined. Recent discussions in the literature have echoed much older proposals suggesting that 'negative emissions', namely, sequestering carbon on a large scale from the atmosphere, is possible. However, such proposals are highly speculative at this point (see Kartha and Dooley 2016; Smith et al. 2016). Another possibility is to neglect the past cumulative emissions, but this certainly appears to be inequitable to many. A third alternative chooses a middle path in including past emissions in determining the entitlements to future cumulative emissions (Kanitkar et al. 2013). Other parameters may be included in determining responsibility and capability, including per capita GDP or non-income human development index (HDI). Such possibilities have been explored in Jayaraman, Kanitkar, and D'Souza (2011).

The advantage of the carbon budget approach is that it eliminates the uncertainties in determining both stabilization trajectories and baseline trajectories characteristic of the CERF in the effort-sharing category. Even more, it allows much flexibility in providing developing countries the flexibility to set their own trajectory of eventual emissions reductions based on their individual national circumstances. The other advantage is that the upfront estimation of an entitlement does not penalize developing countries as a result of future growth. The disadvantage of the approach, however, is that monitoring cumulative emissions may be more difficult as compared to monitoring annual emission flows, and monitoring adherence by countries to their declared cumulative emissions budget will be a little more complicated.

Equity and the Paris Agreement

In the climate negotiations after the raw differentiation of the KP came under considerable pressure, the developing countries have by and large failed to provide any detailed credible scheme to

operationalize equity in long-term mitigation goals. The reasons are not far to seek. Many smaller developing countries, especially outside the ranks of the emerging economies including India, neither have nor aspire to have large industrial bases and are far more concerned with adaptation and adaptation finance issues. This is particularly true of the small island states which have little sympathy with equity issues in long-term mitigation and consider it a distraction in achieving rapid emissions reductions for their safety. The sole exception to this failure has been the Brazilian proposal. However, with its rejection of the per capita principle or any weighting for economic and social vulnerability, it met with little support from either of the two sides.

Much of the equity discussion, from Bali to Copenhagen, was devoted to pushing back the inequity of the top-down emission reduction mechanisms put forward by the developed countries who demanded that all developing countries should declare their emissions reduction trajectory in advance for any viable programme for emissions reduction. However, as has been perceptively noted, many emerging economies, particularly India, tended to use equity 'as a shield rather than a sword' (see Rajamani 2013) and no specific scheme for operationalizing equity in long-term mitigation goals was ever put explicitly on the negotiating agenda.

In the event, COP 15 at Copenhagen initiated the process of turning back on the global allocation of mitigation goals. By the time the Paris Agreement was signed, there was ostensibly no trace left of it, and all countries merely had to pledge to adhere to their self-determined targets. The Paris Agreement also explicitly turned its back on historical responsibility. Nevertheless, even as this agreement was being negotiated, it was clear that in order to simply even assess the adequacy of the Intended Nationally Determined Contribution (INDC) of each country, it required some top-down global allocation mechanism. Following the Paris Agreement itself, in the Global Stocktake (GST), a five-year review of the Nationally Determined Contributions (NDCs) (what the INDCs became after the Agreement was signed) submitted by parties to the UNFCCC, the aggregate effect of the NDCs and their adequacy to meet the temperature targets is to be reviewed in the light of equity as specified in Article 14 of the Paris Agreement.

Equity as the basis for reviewing the adequacy of actions is, therefore, still relevant in the global negotiations.

Over the years since the UNFCCC was signed, China has moved further along the spectrum from emerging economy status to near-developed status. Its stance on equity has clearly undergone a shift from the earlier period—a shift made evident in a joint Obama–Xi Jinping declaration prior to the Paris conference stating that they were committed to implement climate action and encourage other parties to do the same, despite the fact that many aspects of equity and its operationalization were not clear at this point and continue to remain ambiguous even now.³ Given this statement and the stance it signals, China is unlikely to lead the charge on equity in the negotiations. If India is to claim its due share of carbon space and promote an equitable solution to the issue of the adequacy and enhancement of the NDCs, then it must begin to articulate its concerns more clearly at the current critical stage while the modalities of the implementation of the Paris Agreement are being worked out.

Perhaps the more serious issue with the Paris Agreement is that its goal of striving to keep the rise in global temperatures below 1.5°C is likely to be unattainable, since the carbon budget left to the world until the end of the century is likely to be exceeded fairly soon, and certainly by 2035–50, at current rates of emissions reduction (Jayaraman and Kanitkar 2016). The release of the IPCC special report signals this fact clearly, even though there appears to be some ambiguity in the manner in which the feasibility of restricting temperature rise to 1.5°C is discussed in the report (IPCC 2018). Given the nature of the NDCs, even the 2°C goal appears very difficult to attain. It is not unlikely, unless there is a serious and dramatic course correction, that at some point in time in the future, the globe will have to declare a climate emergency. It is in such a scenario that the challenge of equity in all aspects of climate action is likely to be unprecedentedly severe.

³ Available at <https://obamawhitehouse.archives.gov/the-press-office/2016/03/31/us-china-joint-presidential-statement-climate-change>; accessed on 30 May 2019.

References

- Ayers, Jessica M. and Saleemul Huq. 2009. 'Supporting Adaptation to Climate Change: What Role for Official Development Assistance?', *Development Policy Review*, 27(6): 675–92.
- Baer, Paul, Tom Athanasiou, and Sivan Kartha. 2007. *The Right to Development in a Climate Constrained World: The Greenhouse Development Rights Framework*. Berlin: Heinrich Boell Foundation, Christian Aid, EcoEquity, and Stockholm Environment Institute.
- Cazorla, Marina and Michael Toman. 2001. 'International Equity and Climate Change Policy', in Michael Toman (ed.), *Climate Change Economics and Policy: An RFF Anthology*, pp. 235–47. Washington, DC: RFF Press.
- Climate Action Tracker. 2015. 'Climate Pledges will Bring 2.7°C of Warming, Potential for More Action', available at <http://climateaction-tracker.org/news/253/Climate-pledges-will-bring-2.7C-of-warming-potential-for-more-action.html>; accessed on 1 November 2018.
- Denton, F. 2010. 'Financing Adaptation in Least Developed Countries in West Africa: Is Finance the "Real Deal"?', *Climate Policy*, 10(6): 655–71.
- German Advisory Council on Climate Change (WBGU). 2009. 'Solving the Climate Dilemma: The Budget Approach', in *Special Report of the German Advisory Council on Global Change (WBGU)*. Berlin: WBGU. Available at <https://www.wbgu.de/en/special-reports/sr-2009-budget-approach/>.
- Harvey, Fiona. 2013. 'IPCC's "Carbon Budget" Will Not Drive Warsaw Talks, Says Christiana Figueres', *The Guardian*, 24 October, available at <https://www.theguardian.com/environment/2013/oct/24/ipcc-carbon-budget-warsaw-climate-change-christiana-figueres>.
- Höhne, Niklas, Michel den Elzen, and Martin Weiss. 2006. 'Common but Differentiated Convergence (CDC): A New Conceptual Approach to Long-term Climate Policy', *Climate Policy*, 6(2): 181–99.
- Holz, Christian, Sivan Kartha, and Tom Athanasiou. 2018. 'Fairly Sharing 1.5: National Fair Shares of a 1.5 C-compliant Global Mitigation Effort', *International Environmental Agreements: Politics, Law and Economics*, 18(1): 117–34.
- Intergovernmental Panel on Climate Change (IPCC). 2013. 'The Physical Science Basis', in T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds), *Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK, and New York, NY: Cambridge University Press.

- . 2018. *Global Warming of 1.5 Degrees C: An IPCC Special Report on the Impacts of Global Warming of 1.5 °C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, available at http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf, accessed on 22 October 2018.
- Jayaraman, T., and T. Kanitkar. 2016. 'The Paris Agreement'. *Economic & Political Weekly*, 51(3).
- Jayaraman, T., Tejal Kanitkar, and Mario D'Souza. 2011. 'Equitable Access to Sustainable Development: An Indian Approach', *Equitable Access to Sustainable Development: Contribution to the Body of Scientific Knowledge*, pp. 59–77, available at <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.684.4372&rep=rep1&type=pdf>; accessed on 1 June 2019.
- Jiahua Pan and Ying Chen. 2009. 'The Carbon Budget Scheme: An Institutional Framework for a Fair and Sustainable World Climate Regime [J]', *Social Sciences in China*, 5(6): 83–98.
- Kanitkar, Tejal, T. Jayaraman, Mario D'Souza, Mukul Sanwal, Prabir Purkayastha, Rajbans Talwar, and D. Raghunandan. 2010. 'Meeting Equity in a Finite Carbon World,' in *Proceedings of Global Carbon Budgets and Burden Sharing in Mitigation Actions*. Ministry of Environment and Forests, Government of India.
- Kanitkar, Tejal, T. Jayaraman, Mario D'Souza, and Prabir Purkayastha. 2013. 'Carbon Budgets for Climate Change Mitigation—A GAMS-based Emissions Model', *Current Science*, 104(9): 1200–6.
- Kartha, Sivan and Kate Dooley. 2016. 'The Risks of Relying on Tomorrow's "Negative Emissions" to Guide Today's Mitigation Action', Working Paper 2019–8, Stockholm Environmental Institute, Somerville, August. Available at <http://www.jstor.org/stable/resrep02826>.
- Konow, James. 2000. 'Fair Shares: Accountability and Cognitive Dissonance in Allocation Decisions', *American Economic Review*, 90(4): 1072–91.
- . 2003. 'Which Is the Fairest One of All? A Positive Analysis of Justice Theories', *Journal of Economic Literature*, 41(4): 1188–239.
- Metz, Bert. 2000. 'International Equity in Climate Change Policy', *Integrated Assessment*, 1(2): 111–26.
- Meyer, Aubrey. 1999. 'The Kyoto Protocol and the Emergence of "Contraction and Convergence" as a Framework for an International Political Solution to Greenhouse Gas Emissions Abatement', in Olav Hohmeyer and K. Rennings (eds), *Man-made Climate Change*, pp. 291–345. Heidelberg: Physica-Verlag.
- Ministry of External Affairs, Government of India. 2007. 'PM's Intervention on Climate Change at the Heiligendamm Meeting', Berlin, 8 June,

- available at <https://mea.gov.in/in-focus-article.htm?18822/PMs+intervention+on+Climate+Change+at+the+Heiligendamm+meeting>.
- Nakicenovic, Nebojsa, Joseph Alcamo, Gerald Davis, Bert de Vries, Joergen Fenhann, Stuart Gaffin, Kenneth Gregory, Arnulf Grubler, Tae Yong Jung, Tom Kram, Emilio Lebre La Rovere. 2000. 'Special Report on Emissions Scenarios: A Special Report of Working Group III of the Intergovernmental Panel on Climate Change (No. PNNL-SA-39650)'. Pacific Northwest National Laboratory, Richland, WA (US), Environmental Molecular Sciences Laboratory (US).
- Pan, Xunzhang, Fei Teng, and Gehua Wang. 2014. 'Sharing Emission Space at an Equitable Basis: Allocation Scheme Based on the Equal Cumulative Emission per Capita Principle', *Applied Energy*, 113: 1810–18.
- Rajamani, Lavanya. 2013. 'Halfway between Durban and Paris', *The Indian Express*, 29 November, available at <http://archive.indianexpress.com/news/halfway-between-durban-and-paris/1200924/0>.
- Ringius, Lasse, Asbjørn Torvanger, and Arild Underdal. 2002. 'Burden Sharing and Fairness Principles in International Climate Policy', *International Environmental Agreements*, 2(1): 1–22.
- Rogelj, Joeri, Michiel Schaeffer, Pierre Friedlingstein, Nathan P. Gillett, Detlef P. Van Vuuren, Keywan Riahi, Myles Allen, and Reto Knutti. 2016. 'Differences between Carbon Budget Estimates Unravelling', *Nature Climate Change*, 6(3): 245–52.
- Schroeder, Doris and Balakrishna Pisupati. 2010. *Ethics, Justice and the Convention on Biological Diversity*. Nairobi: United Nations Environment Program, Nairobi.
- Smit, Barry and Olga Pilifosova. 2003. 'Adaptation to Climate Change in the Context of Sustainable Development and Equity', *Sustainable Development*, 8(9): 9.
- Smith, Joel B., Stephen H. Schneider, Michael Oppenheimer, Gary W. Yohe, William Hare, Michael D. Mastrandrea, Anand Patwardhan et al. 2009. 'Assessing Dangerous Climate Change through an Update of the Intergovernmental Panel on Climate Change (IPCC) "Reasons for Concern"', *Proceedings of the National Academy of Sciences*, 106(11): 4133–7.
- Smith, Pete, Steven J. Davis, Felix Creutzig, Sabine Fuss, Jan Minx, Benoit Gabrielle, Etsushi Kato et al. 2016. 'Biophysical and Economic Limits to Negative CO₂ Emissions', *Nature Climate Change*, 6(1): 42–50.
- Tokarska, Katarzyna B. and Nathan P. Gillett. 2018. 'Cumulative Carbon Emissions Budgets Consistent with 1.5°C Global Warming', *Nature Climate Change*, 8(4): 296–9.

- United Nations Framework Convention on Climate Change (UNFCCC).
1992. 'United Nations Framework Convention on Climate Change',
1771 United Nations Treaty Series, 107, 165.
- . 1997. 'Kyoto Protocol to the United Nations Framework
Convention on Climate Change', 2303 *United Nations Treaty Series*,
148, available at <https://unfccc.int/resource/docs/convkp/kpeng.pdf>;
accessed on 1 June 2019.

India's Engagement in Global Climate Negotiations from Rio to Paris*

Sandeep Sengupta

Global efforts to address climate change through intergovernmental negotiations have been underway for nearly three decades. India has been an active player in this process. This chapter aims to provide an overview of India's engagement in these negotiations, what its principal motivations have been, and how its climate foreign policy behaviour over this entire period might best be explained.

The first section of the chapter charts the role that India played in the creation and defence of the international climate regime set up in the late 1980s and 1990s, characterized by the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP). The second section covers the period following the entry into force of the KP in 2005 until the Durban Platform negotiations in 2011, including the 2009 Copenhagen Summit, when this regime came under considerable contestation and underwent

* This chapter draws upon previous and forthcoming publications of the author (Sengupta [2012b] and Sengupta [forthcoming]).

significant transition. The third section covers India's engagement in the negotiations from 2011 up to the landmark Paris Agreement in 2015 and its entry into force thereafter, when, for many, the existing climate regime was dramatically altered and set on a new course. The final section attempts to explain some of the continuities and changes seen in India's engagement over these different periods.

India's Role in Shaping the UNFCCC and KP: A Period of Regime Creation and Defence

The fact that India intended to play an active role in the international debate on climate change was clear from very early on. Following the passing of United Nations General Assembly (UNGA) Resolution 44/207 in 1989, that called on member states to urgently prepare a 'framework convention' to address this global problem, India wasted little time in articulating its views on the topic and building an effective Southern coalition on it.

At the 'Conference of Select Developing Countries on Global Environmental Issues' convened in New Delhi in April 1990—the first of its kind for developing countries—India succeeded in securing the general support of the developing world for its basic international positions on climate change. These were: first, the primary responsibility for reducing greenhouse gas (GHG) emissions causing the problem of climate change rested with the developed world since they were the ones responsible for producing the bulk of these emissions. Second, the emissions of developing countries were still very low and needed to grow to meet their future development and poverty reduction needs, and hence no GHG reduction targets could be prescribed for them. Third, any formal agreement on climate change needed to provide for technology transfer and funds for developing countries to help them address this challenge (Ministry of Environment and Forests [MoEF] 1990).

India also played a vital role in shaping the background conditions against which the convention negotiations were held. For example, the original draft of the *First Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC) had noted that both developed and developing countries had 'common responsibilities' on climate change. However, recognizing that what got agreed to here could

significantly impact the future commitments that countries would have to accept, India worked closely with other developing nations to ensure that this was amended to become the 'common but differentiated responsibilities' (CBDR) of industrialized and developing countries (Rajan 1997: 108). India also played a key role in ensuring that the convention negotiations were undertaken through an 'Intergovernmental Negotiating Committee' operating under the direct authority of the UNGA—to allow for 'openness, transparency, universality and legitimacy' and the 'full participation' of all states (World Meteorological Organization [WMO]/United Nations Environment Programme [UNEP] 1990: 10)—rather than through other specialized forums, such as UNEP or IPCC, which were being advocated by developed countries at that time.

Having helped create a level playing field, India then went on to play a major role in shaping the substance of the convention itself (see Chapter 8 in this volume). During the entire convention negotiations, India continued to emphasize, more specifically, that: (i) it had 'no legal responsibility' for addressing climate change; (ii) any voluntary mitigation measures that it took needed to be consistent with its national development plans and priorities; (iii) the 'full incremental costs involved' for the same would need to be provided through 'new and additional financial resources' from the developed world; and (iv) the latter would also need to provide developing countries with 'assured access to technology on preferential terms'. Making 'equity' and 'per capita convergence' a central plank of its negotiating stance, it asserted that '[a]n equitable solution can only be found on the basis of significant reductions in levels of per capita emissions of developed countries, so that over a period of years these converge with rising per capita emissions in developing countries' (Dasgupta 1994: 133).

Through a mix of strong Southern coalition building and the presence of significant divisions within the developed world, India was largely successful in securing its core positions in the convention negotiations. Although it was not able to get everything that it wanted (such as agreement on 'per capita convergence'; concrete emission reduction commitments from developed countries; and technology transfer on 'preferential' terms), it was nevertheless able to get its preferences on specific principles and provisions successfully

embedded within the core text of UNFCCC. Thus, the final text of the UNFCCC adopted at Rio in 1992 clearly acknowledged that 'the largest share of historical and current global emissions' originated in developed countries; that per capita emissions in developing countries were 'still relatively low' and their future share of global emissions would need to 'grow to meet their social and development needs'; that 'Parties should protect the climate system ... on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities' (CBDR&RC); and that '[a]ccordingly, the developed country Parties should take the lead in combating climate change' (UNFCCC 1992: Preamble, Article 3.1). It also specifically called on developed countries to aim to return their GHG emissions to 1990 levels by the year 2000 (Article 4.2a and b) and to provide developing countries with 'new and additional financial resources' to meet not only the 'agreed full incremental costs' of implementing climate mitigation and adaptation measures, including for technology transfer, but also the 'agreed full costs' of preparing their national communications and other reporting requirements (Article 4.3).

On India's insistence, the UNFCCC also confined its review function to conducting individual reviews of only the developed country commitments, while assessing the commitments and communications of developing countries in 'aggregated' terms (Article 10.2). Most importantly, from India's perspective, the UNFCCC explicitly recognized that 'economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties' and that the extent to which developing countries would be able to effectively implement their commitments under the Convention would depend on the extent to which developed countries fulfilled their own commitments with regard to finance and technology transfer (Article 4.7). The Convention, moreover, created two clearly distinct categories of parties—Annex I and non-Annex I—within the basic architecture of the regime itself to recognize the differential obligations and treatment of developed and developing countries.

As the head of India's delegation in these negotiations, Ambassador Chandrashekhar Dasgupta later acknowledged, India's main objective was to ensure that the obligations imposed on developing countries

like itself were 'minimal' and that 'differentiation' was maintained between developed and developing countries 'in all areas'. Overall, his assessment was that the outcome of the convention negotiations was 'entirely satisfactory' from India's point of view (cited in Rajan 1997: 151–2).

Following the entry into force of the UNFCCC in 1994, the discussions quickly turned to reviewing the adequacy of the central commitment made under the Convention by Annex I parties (that is, developed countries) to stabilize their emissions to 1990 levels by the year 2000. At the first Conference of the Parties (COP 1) held in Berlin in 1995, a number of developed countries, however, attempted to shift the focus of this review by calling on the 'more advanced' developing countries to also take on mitigation commitments, and for the establishment of 'new categories' in the UNFCCC beyond the 'developed/developing' (Annex I/non-Annex I) divide (Oberthür and Ott 1999). This was one of the first manifestations of the concerted effort that developed countries would make over the next two decades to revise the fundamental structure of the UNFCCC regime that had been agreed to by all at Rio.

At COP 1, India used its coalition-building skills to considerable effect to ward off this Northern demand. At this point, both the European Union (EU), led by Germany, and the Alliance of Small Island States (AOSIS) were strongly in favour of developing a new protocol to the UNFCCC that would give greater teeth to the Convention by prescribing specific legally binding mitigation 'targets and timetables' for countries. This was, however, opposed by a US-led coalition that included Japan, Canada, Australia, and New Zealand (JUSCANZ) and by members of the Organization of Petroleum Exporting Countries (OPEC). Exploiting these differences, India convened a 'Green Group' of 72 like-minded developing states—including AOSIS but excluding OPEC—that jointly called for the development of a strong legally binding protocol but *without* any additional commitments for developing countries (Paterson 1996).

Leveraging the support of international climate non-governmental organizations (NGOs), who also advocated a strong protocol and were sympathetic to developing country concerns, India then impressed upon Germany and the EU that they had to choose

between either having a strong protocol or additional commitments for 'more advanced' developing states. Ultimately, the India-led coalition succeeded in winning over the EU to its side and in persuading the JUSCANZ group to drop its insistence on additional developing country commitments. Consequently, the 'Berlin Mandate', adopted at the end of COP 1, called for the development of a protocol with quantified emission reduction targets *only* for developed countries and explicitly noted that the process should 'not introduce any new commitments' for developing countries (UNFCCC 1995). This was a striking example of India's ability to engineer creative alliances and shape the climate negotiations to protect its own narrowly defined interests on this issue, which were to avoid any new obligations for developing countries and maintain the sharply differentiated architecture of the UNFCCC.

Following two years of intense negotiations, the KP to the UNFCCC was formally adopted at COP 3 in December 1997. Under this treaty, developed countries agreed to take on individual, quantified, legally binding emission reduction targets to reduce their collective emissions by 5 per cent below 1990 levels over the first commitment period of 2008–12 (UNFCCC 1997: Article 3.1). Although repeated attempts were made even during this phase to introduce the concept of 'voluntary commitments' for developing countries, India, in concert with other members of the G77 and especially China, managed to successfully fend these off. Its environment minister, for instance, highlighted at Kyoto that: 'India categorically rejects ideas suggesting any new commitments for developing countries. Any idea that seeks further to deprive us of our equitable entitlement to grow can never be allowed to take root' (cited in Agarwal, Narain, and Sharma 1999: 59).

The period between 1997 and 2001 largely focused on developing the various modalities and rules for operationalizing the KP, including for the flexible market-based mechanisms that had been negotiated within the treaty to assist developed countries to meet their mitigation targets.

One of these flexible mechanisms, the Clean Development Mechanism (CDM), which allowed for developed countries to invest in specific emission reduction projects in developing countries and use the credits so generated to meet their own mitigation

targets, was of particular interest to India. This was something that India had originally opposed, and accepted only very reluctantly at the end of COP 3, out of concerns that it was a Northern ploy to shift emission reduction obligations to the South on the cheap (Agarwal, Narain, and Sharma 1999). However, this was also one of the few issues on which India changed its mind during the post-Kyoto phase, sensing that the CDM offered a valuable opportunity for it to gain foreign investment and clean technology from the West. Indeed, India not only played an active role in designing the principles, rules, and institutions governing the CDM during this period but, together with China, also became a global leader in hosting CDM projects in the years that followed, with its private sector capturing a significant share of the global market on them (Newell and Bumpus 2012: 54).

This period of regime building came to an end when all the rules for implementing the KP were formally adopted in the form of the 'Marrakesh Accords' at COP 7 in 2001—and when the Protocol formally entered into force in 2005, just prior to COP 11 in Montreal.

From Montreal (2005) to Cancun (2010): A Period of Regime Contestation and Transition

Following the successful entry into force of the KP, discussions immediately turned to what would happen to the climate regime, post-2012, once the 'first commitment period' of the KP ended.

The ability of the KP to deliver meaningful change on the ground had already been called into question by the US decision not to ratify it in 2001 and the continually growing emissions of Organisation for Economic Co-operation and Development (OECD) countries between 1990 and 2004—with most of them remaining far 'off track' their agreed mitigation targets (United Nations Development Programme [UNDP] 2007: 54).

Developed countries, on their part, however, forcefully raised the issue of developing country participation again. Noting, for example, that China was projected to surpass the US as the world's largest GHG emitter in 2007 and India was projected to become the world's third-largest GHG emitter by 2015 (International Energy

Agency [IEA] 2007: 11), they argued that no long-term solution could be found without the active engagement of these fast-growing developing states. They furthermore asserted that anything they did to reduce their own emissions would simply be neutralized by the growing emissions of these emerging economic giants.

In order to resolve this stand-off, COP 11 launched a dual-track process to not only discuss the post-2012 'second commitment period' mitigation targets of Annex I parties that had ratified the KP (the KP track), but also a separate parallel 'dialogue' on 'long-term cooperative action' (the LCA track) to discuss the future commitments of those countries that had either refused to ratify the treaty (such as the US or Australia) or had no binding emission reduction obligations under it, that is, developing nations (UNFCCC 2006).

This was also a time when climate change began to be discussed not only within the multilateral UNFCCC framework but also in other politically important 'minilateral' forums—where traditional developing country coalitions held significantly lesser sway. For example, in June 2007, Germany invited the leaders of the five largest emerging economies (China, India, Brazil, South Africa, and Mexico) to attend the G8 Summit in Heiligendamm—in an enlarged G8+5 setting—and made climate change a key focus of its agenda.

At this G8+5 Summit, India's prime minister, Manmohan Singh, restated and defended the country's core positions on the topic. Noting India's low per capita (and even aggregate) emissions, he stressed that the time was 'not ripe for developing countries to take quantitative targets as these would be counter-productive on their development processes' (Singh 2007). However, in a significant show of flexibility, and emphasizing that India 'recognise[d] wholeheartedly' its 'responsibilities as a developing country', he also went on to unilaterally pledge that 'India's per-capita GHG emissions are *not going to exceed* those of developed countries even while pursuing policies of development and economic growth' (Singh 2007; emphasis added).

This was for the first time in the history of the climate talks that India had made such a voluntary offer to constrain its future potential emissions in any way. However, a careful reading of

this pledge also clearly shows that it was as much a challenge to the developed world to reduce its own per capita emissions first, given the vast gap that existed in this regard. Moreover, it was also essentially consistent with India's long-standing position on 'per capita convergence', and hence did not reflect a major change in its international stance as such.

That India was unwilling to brook any dilution in the fundamental architecture of the UNFCCC was also made clear during the negotiation of the Bali Action Plan during COP 13 in December 2007. As this was a crucial document that aimed to set the terms for an 'agreed outcome' under the LCA track to be reached by COP 15 in Copenhagen in 2009, India worked closely with other developing states to ensure that its content remained as consistent as possible with the framework and principles of the UNFCCC and KP (UNFCCC 2008). It particularly tried to ensure that a clear 'differentiation', or 'firewall', was maintained between what developed and developing countries would each be required to do on climate mitigation in the future—insisting, especially, that the latter was made contingent on the provision of external support from the former. Likewise, on the issue of international measurement, reporting, and verification (MRV) of developing country mitigation efforts—a key Western concern—it ensured that such external scrutiny was contemplated only for those actions that were externally supported by the developed world, and not generally.

The two years that followed, between 2007 and 2009, remained essentially a period of North–South deadlock. Although the Indian government took a number of steps domestically at this time, which signalled the growing importance that it accorded to tackling this issue—including the launch of a National Action Plan on Climate Change (NAPCC) in 2008 that outlined concrete measures across eight key areas to promote 'development objectives while also yielding *co-benefits* for addressing climate change effectively' (Prime Minister's Council on Climate Change [PMCCC] 2008; emphasis added)—its international positions remained largely unaltered.

However, the pressure on India and other major developing countries to accept a different sort of climate regime continued unabated. The first significant shifts in India's climate foreign policy were witnessed in July 2009, when Prime Minister Manmohan Singh—following the return to power of the United Progressive

Alliance (UPA) in the 2009 General Elections—signed the ‘Major Economies Forum (MEF) Leaders Declaration on Energy and Climate’ at a meeting held alongside the G8 Summit in L’Aquila, Italy. This declaration specifically recognized, for the first time, that the rise in global temperature ‘ought not to exceed 2 degrees C’ and that the MEF countries would work together to identify a ‘global goal’ to reduce ‘global emissions by 2050’ (MEF 2009). Although only a political declaration, and not legally binding, India’s signing on to this ‘2 degree C’ temperature rise limit nevertheless signalled its willingness to concede, in theory at least, an implicit cap on its future emissions, even though this was left ambiguous and unstated (Ramachandran 2009).

The fact that India’s political leadership was now willing to reconsider its international stance became further clear when Jairam Ramesh, the country’s newly appointed environment minister, actively attempted to reframe India’s traditional position on climate change in the months leading up to the Copenhagen Summit. Stressing repeatedly that India was highly vulnerable to climate change—and also that it needed to be seen internationally as ‘a leader, as a proactive player, as somebody who is shaping the solution’ on this issue—Ramesh argued that it was now in the country’s own interest to go beyond its original ‘per capita convergence’ position and adopt a more aggressive ‘per-capita plus’ approach, whereby specific ‘performance targets’ could be assigned through domestic legislation, or executive action, to key sectors of the country’s economy (Ghosh 2009). He also suggested taking a more flexible stance on the question of allowing external reviews of India’s domestic mitigation actions (Sethi 2009).

These new ideas provoked a great deal of domestic debate in the country, including within government, which saw strong concerns about the seemingly unilateral nature of these concessions being expressed by senior members of India’s official climate negotiating team itself (*TNN* 2009). It also led to India’s climate foreign policy being extensively debated within its Parliament. In the final parliamentary debate held just prior to COP 15, Environment Minister Ramesh declared that India would go to Copenhagen with a ‘positive frame of mind’ and was prepared to be ‘flexible’, but stressed there were three ‘non-negotiables’ that it would not compromise on: (i) it would not accept any ‘legally binding emission reduction

cut'; (ii) it would not accept any 'peaking year'—a concept that had started emerging at this time; and (iii) it would not allow unsupported mitigation actions to be subject to the same type of scrutiny as those that were externally supported. However—in a clear shift of position from India's opposition to 'voluntary commitments' in the pre-Kyoto period and even from the prime minister's 2007 statement at Heiligendamm—Ramesh announced that India would voluntarily reduce the 'emissions intensity' of its gross domestic product (GDP) by 20–5 per cent by 2020 compared to its 2005 level through domestic mitigation actions, arguing that to do so would be in India's own best interests (Lok Sabha 2009). This was for the first time that India formally put forward a concrete numerical pledge in relation to climate mitigation on the table.

At COP 15 in Copenhagen, India coordinated extremely closely with a core group of similarly placed large developing nations (China, Brazil, and South Africa)—through the newly formed BASIC alliance—to jointly resist the mounting pressure that they now each came under from a largely unified US-led North. The latter insisted that the BASIC states not only accept stronger mitigation commitments but also that the KP, which they considered as fundamentally flawed, be replaced by a new, more 'undifferentiated' international agreement on climate change, where all major GHG emitters, developed and developing alike, would have similar mitigation obligations subject to similar levels of international scrutiny.

This Northern attempt to bypass the KP, and dilute the foundational norm of 'differentiation' that had been hardwired into the UNFCCC, was strongly opposed by the BASIC group and most other developing nations. It was in this intractable situation that the 'Copenhagen Accord' was uneasily born on the final night of COP 15, as a last-minute compromise between the BASIC countries and the US at their heads of state and government (HoSG) level. In the Accord negotiations, India worked actively to ensure that none of the three 'non-negotiables' that it had promised to its Parliament were fundamentally violated. It also played a key role in brokering agreement on the sensitive question of MRV by suggesting a less intrusive alternative of 'international consultations and analysis' to review the unsupported mitigation actions of developing countries (Chauhan 2010). The BASIC countries collectively also ensured that some of

the fundamental principles and provisions of the UNFCCC (such as ‘CBDR&RC’, ‘equity’, ‘new and additional’ finance, and recognition for the ‘overriding priorities’ of poverty eradication and development) were suitably acknowledged and referenced in the Accord. A ‘differentiated’ framework for recording the ‘quantified economy-wide emissions targets’ of developed countries and the ‘nationally appropriate mitigation actions’ of developing countries that both agreed to submit under the Accord was also ensured (UNFCCC 2010).

However, the inability of parties to realize an ‘agreed outcome’ at COP 15 as mandated by the 2007 Bali Action Plan—with the Copenhagen Accord only being ‘take[n] note of’ but not formally adopted—highlighted the deep political fissures that still existed between major developing and developed countries over what sort of international regime could deliver effective global action on climate change. While the former generally continued to insist on the implementation of a ‘top-down’, ‘strictly differentiated’, ‘legally binding’, ‘targets and timetables’-based approach, exemplified by the UNFCCC and its KP, key developed states, especially the US, advocated a radically altered regime that would replace Kyoto with a ‘more voluntary’, ‘less differentiated’, ‘bottom-up’, ‘pledge and review’-type system that would also require significant mitigation commitments and accountability from key developing countries.

Countries formally agreed to extend the ‘dual-track’ mode of negotiations—and the political understandings reached under the Copenhagen Accord (on restricting temperature rise to 2°C, registering and monitoring the mitigation commitments and actions of developed and developing countries, developed country commitments on finance, etc.) were successfully anchored within the Cancun Agreements at COP 16 the following year. But what became increasingly clear was that, notwithstanding the flexibility shown by countries such as India, the *ancien régime* was now under severe contestation and in a period of definite transition.

From Durban (2011) to Paris (2015): A Period of Regime Change and Acceptance

The clearest evidence of which way the winds were blowing became apparent at COP 17 in Durban in 2011. Although India, represented

by a new environment minister, Jayanthi Natarajan, stressed that '[w]e cannot accept the principle of CBDR to be diluted. The firewall of CBDR must not be broken. Equity in the debate must be secured' (MoEF 2011), the final outcome of the conference could not be more different. Despite its entreaties, a decision was taken to terminate the 'dual-track' negotiations by the end of 2012 and to launch a singular new negotiating track in its place that called for the development of a 'protocol, another legal instrument or an agreed outcome with legal force under the Convention' by COP 21 in 2015, which would be 'applicable to all Parties' and be implemented from 2020 (UNFCCC 2012). Indeed, it was only through India's frenetic solitary efforts to avoid any 'universally applicable' legally binding instrument (a red line for it)—and its last-minute 'huddle' with the EU—that the third option of 'an agreed outcome with legal force' was even included in this mandate (Dubash and Rajamani 2015). However, what became amply clear was that, unlike the Bali mandate which had maintained a clear 'firewall' between developed and developing countries, this new 'Durban Platform for Enhanced Action'—despite India's voluble and repeated opposition—made no obvious distinction between developed and developing nations. Moreover, unlike the Copenhagen Accord and the Cancun Agreements, which had explicitly reaffirmed the core UNFCCC norms of 'equity' and 'CBDR&RC', the Durban Platform text made no reference whatsoever to either of these foundational regime principles (Sengupta 2012a). The Durban conference also revealed the extent to which Northern unity and growing fragmentation within the South, including in the BASIC group, now left India isolated and fighting its own corner. Although the KP continued to survive on paper, with developed countries agreeing at COP 18 in Doha the following year—on the insistence of the South—to a 'second commitment period' that would extend from 2012 to 2020, the fact that few industrialized states were willing to make any serious commitments under it underscored the extent to which the KP remained marginal to the process.

The period between 2012 and 2015 focused primarily on designing a new global climate agreement based on the new terms defined at Durban. At COP 19 in Warsaw in 2013, all parties to the UNFCCC were invited to voluntarily prepare and communicate their 'bottom-up' national-level pledges on climate action—or

Intended Nationally Determined Contributions (INDCs)—in support of the 2015 agreement. COP 20, held in Lima in 2014, continued to develop the contours of this new agreement. At this juncture, a renewed pushback from the developing world, particularly from the BASIC group—and a newly created Southern alliance called the Like-Minded Developing Countries (LMDC), of which India was a core member—brought the issue of ‘differentiation’ back on the table, through their repeated insistence that the 2015 agreement had to remain fully consistent with the agreed provisions and principles of the UNFCCC regime, which, they stressed, could not undergo ‘rewriting, revising or reinterpreting’ (Kallbekken, Sælen, and Underdal 2014: 42).

The formal compromise that was ultimately agreed to on this in Lima was that the 2015 agreement would reflect the principle of CBDR&RC ‘in light of different national circumstances’ (UNFCCC 2015). In other words, no longer would the original Rio concept of ‘differentiation’—as understood in terms of a strict divide between Annex I and non-Annex I party obligations and treatment—apply. Consequently, the Paris Agreement that was finally adopted at COP 21 in December 2015 incorporated the principle of differentiation within its text in a very different manner than had been originally conceptualized under the UNFCCC and its KP (see Chapter 12 in this volume). Intense negotiations, particularly by the BASIC and LMDC groups, throughout the months leading up to COP 21 ensured that ideas of ‘equity’ and ‘differentiation’ remained registered in different operational parts of this new treaty—and India played a key role in this process. Ultimately, the Paris Agreement agreed to at COP 21—with its nuanced and ‘carefully calibrated mix of hard, soft and non-obligations’ (Rajamani 2016: 337) and its ‘sovereignty-preserving NDCs’ (Dubash et al. 2018)—arguably took into account at least some of India’s core concerns. Nevertheless, it represented a clear shift from the UNFCCC/KP framework in its much more symmetrical treatment of all parties, developed and developing alike, than had previously been the case, which India—ultimately in the end—was left with little choice but to acquiesce to.

Publicly, however, India—represented at COP 21 by a new Bharatiya Janata Party (BJP) government led by Prime Minister Narendra Modi, which had taken over the reins of the climate

negotiations in May 2014, following their victory in the 2014 General Elections—welcomed the adoption of the Paris Agreement. Indeed, just prior to COP 21, in October 2015, India communicated its own updated national pledge, or INDC, to the UNFCCC (see Chapter 19 in this volume). In this, India significantly enhanced its earlier pre-Copenhagen pledge of 2009, agreeing to reduce the ‘emissions intensity’ of its GDP by 33–5 per cent by 2030 from 2005 levels (Government of India [GoI] 2015: 29). Moreover, India’s INDC also included other specific time-bound targets to increase both the share of the country’s national energy that would be derived from non-fossil fuel sources and its national tree and forest cover, among other measures. It, however, took care to note that its INDC did ‘not bind it to any sector specific mitigation obligation or action’ and that its successful implementation would be ‘contingent upon an ambitious global agreement including additional means of implementation to be provided by developed country parties’, in accordance with specific articles of the UNFCCC (GoI 2015: 30).

At COP 21 itself, Prime Minister Modi made active efforts to position India as a country that was fully aware of its global responsibilities on this issue. As a mark of its global commitment towards addressing climate change, the Modi government, in fact, also launched a new initiative together with France—the ‘International Solar Alliance’—aimed at significantly expanding the global adoption of solar energy, especially across the tropics. This was in addition to the domestic decision that the Modi government had previously taken in June 2015: to increase India’s national solar power generation capacity fivefold, from 20 GW to 100 GW by 2022, compared to the original goal that had been set in its NAPCC in 2008.

Following COP 21, India has continued to reiterate its political support for the Paris Agreement. This could be seen, for instance, through the remarkably rapid decision of the Indian government to officially ratify the Paris Agreement in October 2016, which subsequently successfully entered into force in November 2016. Likewise, India publicly also voiced its strong support for the Agreement in June 2017 after the Trump administration’s announcement to withdraw the US from the treaty, with Prime Minister Modi asserting at a joint press conference with President Macron of France that the

‘protection of the environment and the mother planet is an article of faith’ (De Clercq 2017).

Nevertheless, in the technical negotiations that have followed since on the development of the Paris Agreement ‘rulebook’ that will make the treaty operational in 2020, Indian negotiators working together with the BASIC and LMDC groups have continued to seek ways to incorporate more traditional understandings on differentiation and conditionality of action within these emerging rules (LMDC 2017). Likewise, they have continued to raise the importance of enhanced developed country ambition and support, including on their climate finance commitments, in both the pre- and post-2020 periods, for ensuring the long-term success of the Paris Agreement (Table 7.1). What this suggests is that despite the new understandings that were ostensibly reached at Paris, the new regime remains fragile. Considerable differences of interpretation over what precisely was agreed to at Paris still exist among the negotiators. To what extent such ambiguity and contestation will affect progressive climate action remains to be seen.

Table 7.1 Timeline of Key Events in Climate Change Negotiations

Year	International Events	Indian Events
1989	<ul style="list-style-type: none"> • UNGA Resolution 44/207 calls for ‘framework convention’. 	<ul style="list-style-type: none"> • MoEF constitutes ‘Expert Advisory Committee’ on global environmental issues.
1990	<ul style="list-style-type: none"> • IPCC <i>First Assessment Report</i>. • Intergovernmental Negotiating Committee (INC) established. 	<ul style="list-style-type: none"> • India hosts ‘Conference of Select Developing Countries on Global Environmental Issues’.
1991	<ul style="list-style-type: none"> • INC negotiations. 	<ul style="list-style-type: none"> • Economic crisis in India.
1992	<ul style="list-style-type: none"> • UNFCCC signed at Rio. 	<ul style="list-style-type: none"> • India signs UNFCCC.
1993		<ul style="list-style-type: none"> • India ratifies UNFCCC.
1994	<ul style="list-style-type: none"> • UNFCCC enters into force. 	
1995	<ul style="list-style-type: none"> • COP 1 adopts ‘Berlin Mandate’. • IPCC <i>Second Assessment Report</i>. 	
1997	<ul style="list-style-type: none"> • KP adopted at COP 3. 	

(cont'd)

Table 7.1 (cont'd)

Year	International Events	Indian Events
2001	<ul style="list-style-type: none"> • IPCC <i>Third Assessment Report</i>. • Marrakesh Accords adopted at COP 7. 	
2002	<ul style="list-style-type: none"> • COP 8 prioritizes 'climate adaptation'. 	<ul style="list-style-type: none"> • India ratifies KP. • India hosts COP 8 in Delhi.
2003		<ul style="list-style-type: none"> • India establishes National CDM Authority.
2005	<ul style="list-style-type: none"> • KP enters into force. • Ad Hoc Working Group on KP (AWG-KP) established at COP 11 to discuss 'second commitment period' targets. • 'Dialogue' launched at COP 11 on LCA. 	
2007	<ul style="list-style-type: none"> • G8+5 Summit at Heiligendamm, Germany. • IPCC <i>Fourth Assessment Report</i>. • Bali Action Plan adopted at COP 13. • Ad Hoc Working Group on LCA (AWG-LCA) established at COP 13. 	<ul style="list-style-type: none"> • PMCCC established. • Prime minister's pledge at Heiligendamm.
2008	<ul style="list-style-type: none"> • AWG-KP and AWG-LCA sessions at COP 14. 	<ul style="list-style-type: none"> • National Action Plan on Climate Change (NAPCC).
2009	<ul style="list-style-type: none"> • MEF Leaders Declaration at L'Aquila recognizes '2 degree C' limit. • COP 15 'takes note of' Copenhagen Accord. • AWG-KP and AWG-LCA mandates extended to COP 16. 	<ul style="list-style-type: none"> • India signs MEF declaration. • India announces voluntary 'emissions intensity' cut of 20–5% by 2020.
2010	<ul style="list-style-type: none"> • 'Cancun Agreements' adopted at COP 16. • AWG-KP and AWG-LCA mandates extended to COP 17. 	<ul style="list-style-type: none"> • Planning Commission establishes Expert Group on 'low carbon economy'.

- 2011 • 'Durban Platform for Enhanced Action' adopted at COP 17.
- Ad Hoc Working Group on Durban Platform for Enhanced Action (ADP) established at COP 17.
- 2012 • Doha Amendment to KP adopted at COP 18.
- ADP sessions at COP 18.
- 2013 • COP 19 invites parties to prepare and communicate INDCs.
- 2014 • IPCC *Fifth Assessment Report*.
- COP 20 reinterprets CBDR&RC as 'CBDR&RC in light of different national circumstances' (CBDR&RC-NC).
- 2015 • Paris Agreement adopted at COP 21.
- India expands solar power goal fivefold.
- India communicates INDC pledging 'emissions intensity' cut of 33–5% by 2030.
- India launches 'International Solar Alliance' with France.
- 2016 • Paris Agreement enters into force.
- Ad Hoc Working Group on Paris Agreement (APA) established at COP 22 to negotiate Paris Agreement rulebook.
- India ratifies Paris Agreement.
- 2017 • Announcement of the US' withdrawal from Paris Agreement.
- India reiterates support for Paris Agreement.
- APA sessions at COP 23.

Source: Author's compilation.

Explaining India's Behaviour in Global Climate Negotiations

As the world's second-most populous nation, a traditional developing country leader, an emerging global economic and political power, and a significant future emitter of GHGs, India has undoubtedly been one of the central players in international climate negotiations over the last three decades. How can its engagement, and varying impact and influence, in the negotiations over this period best be explained?

India's primary national purpose, since gaining independence after 200 years of colonial rule in 1947, has been to eradicate its deep-rooted poverty, achieve modernization and development through industrialization and economic growth, and regain what it considers as its 'rightful place' in the world (Gadgil and Guha 1992; Saran 2006).

There was an early realization within government that any international agreement to curb GHG emissions—which were intrinsically correlated to national energy use, economic growth, and development—could impinge upon these core national interests and hamper the country's future prospects. As Indian negotiators participating in the convention negotiations in the early 1990s acknowledged, the UNFCCC, to them, was not just an environmental treaty but rather a 'major multilateral economic agreement', in which '[t]he sharing of costs and benefits implied ... could significantly alter the *economic destinies* of individual countries' (Dasgupta 1994: 131; emphasis added).

This interest-based conceptualization of the international climate regime—and the desire to secure enough 'policy space' and 'carbon space' within it to ensure its future development—is what principally drove India's international behaviour on this issue over the years. Furthermore, this was coupled with an equally strong normative sentiment, based on notions of equity and justice, that tackling climate change was not the responsibility of developing countries like India as this was a problem caused primarily by the developed world.

Reasons for Continuity

The fact that India continued to resist any fundamental changes to the UNFCCC/KP regime that it managed to successfully negotiate

in the 1980s and 1990s, in the years that followed, may be attributed also to four additional factors (Sengupta 2012b; Vihma 2011).

First, even though a clear North–South bargain had been struck at Rio in 1992 on how to tackle climate change, there was little movement from the North to actually deliver on its promises, either in terms of reducing its own GHG emissions or in providing technology and finance to the South. On the contrary, the entire effort of the North, COP 1 onwards, seemed focused on undoing and revising the terms of the original Rio deal. In this situation, there was little reason for India to unilaterally change its foreign policy on this issue, especially now that it had international law on its side.

Second, for most of this period, there was a general domestic consensus within India (among government negotiators, political parties, environmental NGOs, business groups, scientists, and the media) that India's external position on climate change was legitimate and valid and did not require any changing. One of the striking features that illustrates this pan-national feeling is that even environmental NGOs that actively criticized the government's domestic environmental policies at home rallied to strongly defend its foreign policies on climate change abroad. For instance, the Centre for Science and Environment (CSE), a New Delhi-based environmental NGO, played a critical role in providing some of the most persuasive normative arguments used by the Indian government in the climate negotiations (see Chapter 5 in this volume), and in marshalling support for its positions among international climate NGO networks at key junctures.

A third reason for the long continuity seen in India's positions stemmed from the nature of the country's internal policymaking apparatus and process itself. Formulating India's external climate policy has traditionally been the preserve of a relatively small group of government officials and diplomats from the MoEF and Ministry of External Affairs, who believe that their core traditional positions are right, and have found little reason to change their worldviews and normative positions on this issue over time.

The fourth reason is the generally limited role that science and scientists, barring some exceptions, have played in determining India's official policies on climate change over the years. Notwithstanding the successive IPCC reports, economic and developmental

considerations, and not environmental concerns or science, have been the predominant forces that have driven India's external thinking and policies on this issue. Moreover, given limited governmental capacity, the natural tendency of the Indian state and its bureaucracy has been to stick to existing orthodoxy, rather than venture out into new uncertain territory.

Reasons for Change

Yet, as the chapter has shown, there have also been significant changes seen in India's climate foreign policy, especially in the lead up to Copenhagen and Paris, even as it tried to simultaneously defend the old regime over this time. These changes can be attributed to at least six key factors.

First, the emergence of powerful new voices within India's policymaking bodies on climate change and, particularly, the internal shift in the balance of power between its political and bureaucratic leadership on this issue (Atteridge et al. 2012). As climate change began to feature more frequently at HoSG-level discussions, it received closer attention within higher echelons of government within India too. Also, the country's highest political leadership—cutting across party lines—was more willing than its bureaucrats to take political risks, and consider and accept options that extended well beyond India's traditional negotiating positions. This was exemplified prominently, for example, in the lead up to the 2009 Copenhagen Summit, in the policy shifts triggered by Environment Minister Ramesh—who expressed significantly differing worldviews, threat perceptions, and normative commitments on this issue than officials traditionally in charge of Indian climate policymaking (Michaelowa and Michaelowa 2012)—and Prime Minister Manmohan Singh's implicit support. It was also equally seen in the more direct role that Prime Minister Modi himself played in making and approving the political judgment calls, trade-offs, and compromises that were observed in the lead up to, at, and following COP 21.

Second, India's understandings of what its core interests are on this topic have also evolved over time. Enabled, in part, by the growing scientific knowledge encapsulated in successive IPCC reports,

there is more appreciation today, including among policymakers, of the country's intrinsic vulnerabilities on this issue—be it the potential impacts of climate change on India's monsoon-dependent agriculture, or its glacier-fed river systems, or its 7,500 kilometre-long coastline—and the need, therefore, for it to take and support early and ambitious global climate action in its own national interest (Thaker and Leiserowitz 2014).

Third, there is also a growing understanding that taking action on climate change does not necessarily have to come at the cost of development, but can be done in a way that yields other material 'co-benefits' for the country, whether in terms of improving local health by tackling household, vehicular, and industrial emissions, or enhancing the country's energy security by lowering dependence on fossil fuel imports and minimizing foreign exchange outflows for the same (Dubash 2013). Moreover, the recognition that cost-competitive alternative energy options based on renewables exist, and offer realistic 'leapfrogging' pathways as well as new business and growth opportunities for the country to achieve clean development, also fed into some of the changes seen in its external policies on this issue.

Fourth, domestic consensus on climate change within India is no longer as solid and unidimensional as it used to be (Dubash et al. 2018). Until the mid-2000s, the landscape of non-state actors working on this issue was dominated largely by institutions such as CSE and The Energy and Resources Institute (TERI), whose views were largely congruent with, and even helped to shape, India's traditional positions. Similarly, domestic business and industry groups such as the Confederation of Indian Industry (CII) and the Federation of Indian Chambers of Commerce and Industry (FICCI) also tended to rally behind these positions, to the extent that they were engaged. In recent years, however, there has been a much greater proliferation of non-state actors domestically engaged on climate change, who represent a much wider variety of views (see Chapter 15 in this volume). Some of these groups—including those with strong transnational connections, such as Greenpeace India and others—have moreover been strongly critical of some of the core precepts that have underpinned India's traditional positions (Ananthapadmanabhan, Srinivas, and Gopal 2007; see Chapter 11 in this volume). Likewise,

new voices have also emerged within Indian industry, which have pointed to the growing business opportunities and advantages that could stem from taking greater and early action on climate change (Godrej and Steer 2016), thereby providing the societal context for India to consider more flexible alternative positions on climate change in recent years.

Fifth, growing international pressure on India also played a critical role in crystallizing the changes that were seen in India's climate foreign policy (Vihma 2011). This was not only the continual pressure that was brought upon it by the developed world but also, and perhaps more crucially, the 'peer pressure' that it came under from its traditional allies in the BASIC group (Sengupta 2012b). When these countries announced their voluntary mitigation pledges and submitted their INDCs in the lead up to COP 15 and COP 21, respectively, it eventually made it politically impossible for India not to follow suit. More generally, the desire to be viewed as a 'responsible member' of the international community—and avoid being isolated and blamed in the event of any failure in the global climate talks—was also a key explanatory factor behind the changes seen in India's positions.

Finally, the wider emergence of India as a powerful economic and political actor on the global stage, since its liberalization in 1991, also had an impact in driving the recent changes seen in its climate foreign policy, with its political leadership reappraising the necessity of pursuing an entirely defensive external strategy on this issue. This was aligned with a growing sentiment within powerful sections of India's political and policymaking establishment that a rising, more confident India should be more willing to shed its hard-line image as a 'naysayer' in international negotiations and assume a position of greater responsibility in all areas of global governance, including on climate change, that befitted its national aspirations for 'great power' status (Hurrell and Sengupta 2012). Furthermore, broader geopolitical changes in the international landscape at large also undoubtedly influenced India's thinking and policies on this issue. For instance, the enhanced importance that it attached to building a closer bilateral relationship with the US and the material and security benefits that it secured in return—such as the 2005 Indo-US nuclear deal—made India more willing to accept the US

and Western preferences on the global climate regime, rather than to simply pursue a line of unidimensional opposition to them.

What is clear from the aforementioned discussion is that although India was highly successful in shaping the original climate regime and defending it for a significant period thereafter, it found international climate negotiations harder to navigate in subsequent years. Growing unity within the developed world, accompanied by greater fragmentation within the developing world, created background conditions that were less favourable compared to what it had to face in the early years of the process. At the same time, however, more recently the international negotiations have opened up new spaces for India to substantively rethink its true national interests on this issue. As it engages in the post-Paris phase of the negotiations, India's challenge will be to sensibly balance the imperative of securing a fair international arrangement, on the one hand, while taking concrete domestic climate action, on the other—in a manner that minimizes the country's vulnerability and maximizes its prospects for national welfare, green growth, and smart development in a carbon-constrained world.

References

- Agarwal, Anil, Sunita Narain, and Anju Sharma (eds). 1999. *Green Politics: Global Environmental Negotiations*. New Delhi: Centre for Science and Environment.
- Ananthapadmanabhan, G., K. Srinivas, and V. Gopal. 2007. *Hiding behind the Poor: A Report by Greenpeace on Climate Injustice in India*. New Delhi: Greenpeace.
- Atteridge, Aaron, Manish Kumar Shrivastava, Neha Pahuja, and Himani Upadhyay. 2012. 'Climate Policy in India: What Shapes International, National and State Policy?', *Ambio*, 41(1): 68–77.
- Chauhan, Chetan. 2010. 'US, China Close in on Carbon Accord', *Hindustan Times*, 3 December. Available at <https://www.hindustantimes.com/delhi-news/us-china-close-in-on-carbon-accord/story-AFYU5mv-vpU3oZ8gpN6nbVJ.html>; accessed on 28 May 2019.
- Dasgupta, Chandrashekhar. 1994. 'The Climate Change Negotiations', in I.M. Mintzer and J.A. Leonard (eds), *Negotiating Climate Change: The Inside Story of the Rio Convention*, pp. 129–48. Cambridge: Cambridge University Press.

- De Clercq, Geert. 2017. 'France, India to Cooperate in Fighting Climate Change', *Reuters*, 3 June. Available at <https://in.reuters.com/article/france-india-modi-macron-climatechange-idINKBN18U0QD>; accessed on 28 May 2019.
- Dubash, Navroz K. 2013. 'The Politics of Climate Change in India: Narratives of Equity and Co-benefits', *WIREs Climate Change*, 4(3): 191–201.
- Dubash, Navroz K., Radhika Khosla, Ulka Kelkar, and Sharachandra Lele. 2018. 'India and Climate Change: Evolving Ideas and Increasing Policy Engagement', *Annual Review of Environment and Resources*, 43: 395–424. Available at <https://doi.org/10.1146/annurev-environ-102017-025809>.
- Dubash, Navroz K. and Lavanya Rajamani. 2015. 'Multilateral Diplomacy on Climate Change', in David M. Malone, C. Raja Mohan and Srinath Raghavan (eds), *Oxford Handbook on Indian Foreign Policy*, pp. 663–77. Oxford: Oxford University Press.
- Gadgil, Madhav and Ramachandra Guha. 1992. *This Fissured Land: An Ecological History of India*. New Delhi: Oxford University Press.
- Ghosh, Padmaparna. 2009. 'I Want to Position India as a Proactive Player: Jairam Ramesh', *Mint*, 29 September. Available at <https://www.livemint.com/Politics/h97ogi3qEaToXuP9T8YTul/I-want-to-position-India-as-a-proactive-player-Jairam-Rames.html>; accessed on 28 May 2019.
- Godrej, Jamshyd and Andrew Steer. 2016. 'Obama and Modi Must Fight Climate Change Together', *Time*, 7 June. Available at <http://time.com/4359888/modi-obama-climate-change/>; accessed on 28 May 2019.
- Government of India (GoI). 2015. 'India's Intended Nationally Determined Contribution: Working towards Climate Justice', Ministry of Environment, Forest and Climate Change, GoI, New Delhi.
- Hurrell, Andrew and Sandeep Sengupta. 2012. 'Emerging Powers, North–South Relations and Global Climate Politics', *International Affairs*, 88(3): 463–84.
- International Energy Agency (IEA). 2007. *World Energy Outlook 2007: China and India Insights*. Paris: IEA.
- Kallbekken, Steffen, Håkon Sælen, and Arild Underdal. 2014. *Equity and Spectrum of Mitigation Commitments in the 2015 Agreement*. Copenhagen: Nordic Council of Ministers.
- Like-Minded Developing Countries (LMDC). 2017. 'LMDC Closing Statement for COP23', Bonn, 17 November. Available at https://www4.unfccc.int/sites/submissions/Lists/OSPSubmissionUpload/896_375_131554375632069219-Closing%20Statement%20of%20Iran%20on%20behalf%20of%20the%20LMDC.pdf; accessed on 28 May 2019.
- Lok Sabha. 2009. 'Transcript of the Minister's Response in the Lok Sabha', Parliament of India, New Delhi, 3 December. Available at

- http://www.moef.nic.in/downloads/public-information/LokSabha_trn-script.pdf; accessed on 28 May 2019.
- Major Economies Forum (MEF). 2009. 'Declaration of the Leaders of the Major Economies Forum on Energy and Climate', L'Aquila, Italy, 9 July. Available at <https://www.theguardian.com/environment/2009/jul/09/climate-change-g8>; accessed on 28 May 2019.
- Michaelowa, Katharina and Axel Michaelowa. 2012. 'India as an Emerging Power in International Climate Negotiations', *Climate Policy*, 12(5): 575–90.
- Ministry of Environment and Forests (MoEF). 1990. 'Greenhouse Effect and Climate Change: Issues for the Developing Countries', in *Proceedings of the Conference of Select Developing Countries on Global Environmental Issues*. New Delhi: MoEF, GoI.
- . 2011. 'Remarks by Smt. Jayanthi Natarajan, Hon'ble Minister for Environment & Forests', Durban, 10 December. Available at <http://envfor.nic.in/downloads/public-information/MEF%20Remarks%20Indaba%20Session%20Dec%2009%201800%20hrs.pdf>.
- Newell, Peter and Adam Bumpus. 2012. 'The Global Political Ecology of the Clean Development Mechanism', *Global Environmental Politics*, 12(4): 49–67.
- Oberthür, Sebastian and Hermann E. Ott. 1999. *The Kyoto Protocol: International Climate Policy for the 21st Century*. Berlin: Springer Science & Business Media.
- Paterson, Matthew. 1996. *Global Warming and Global Politics*. London: Routledge.
- Prime Minister's Council on Climate Change (PMCCC). 2008. 'National Action Plan on Climate Change'. Available at <http://www.moef.nic.in/downloads/home/Pg01-52.pdf>; accessed on 31 October 2018.
- Rajamani, Lavanya. 2016. 'The 2015 Paris Agreement: Interplay between Hard, Soft and Non-Obligations', *Journal of Environmental Law*, 28(2): 337–58.
- Rajan, Mukund Govind. 1997. *Global Environmental Politics: India and the North–South Politics of Global Environmental Issues*. New Delhi: Oxford University Press.
- Ramachandran, R. 2009. 'Climate Change and the Indian Stand', *The Hindu*, 28 July. Available at <https://www.thehindu.com/todays-paper/tp-opinion/Climate-change-and-the-Indian-stand/article16564157.ece>; accessed on 28 May 2019.
- Saran, Shyam. 2006. 'Present Dimensions of the Indian Foreign Policy', Address by Foreign Secretary, Shanghai Institute of International Studies, China, 11 January. Available at <https://bit.ly/2JzI9fj>; accessed on 28 May 2019.
- Sengupta, Sandeep. 2012a. 'Lessons from the Durban Conference', *The Hindu*, 14 February. Available at <https://www.thehindu.com/opinion/>

- lead/lessons-from-the-durban-conference/article2890130.ece; accessed on 28 May 2019.
- . 2012b. 'International Climate Negotiations and India's Role', in Navroz K. Dubash (ed.), *Handbook of Climate Change and India: Development, Politics and Governance*, pp. 101–17. New Delhi: Oxford University Press.
- . Forthcoming. 'Deciphering India's Foreign Policy on Climate Change: The Role of Interests, Institutions and Ideas', in Johannes Plagemann, Sandra Destradi, and Amrita Narlikar (eds), *India Rising: A Multi-Layered Analysis of Ideas, Interests, and Institutions*. New Delhi: Oxford University Press.
- Sethi, Nitin. 2009. 'India Ready for Global Scrutiny on Emissions', *The Times of India*, 28 September. Available at <https://timesofindia.indiatimes.com/india/India-ready-for-global-scrutiny-on-emissions/article-show/5063514.cms>; accessed on 28 May 2019.
- Singh, Manmohan. 2007. 'PM's Intervention on Climate Change at the Heiligendamm Meeting of G8 Plus 5', Berlin, 8 June. Available at <https://mea.gov.in/in-focus-article.htm?18822/PMs+intervention+on+Climate+Change+at+the+Heiligendamm+meeting>; accessed on 28 May 2019.
- Thaker, Jagadish and Anthony Leiserowitz. 2014. 'Shifting Discourses of Climate Change in India', *Climatic Change*, 123(2): 107–19.
- Times News Network (TNN)*. 2009. 'Jairam Persuades Negotiators to Join Climate Talks', *The Times of India*, 7 December. Available at <https://timesofindia.indiatimes.com/india/Jairam-persuades-negotiators-to-join-climate-talks/articleshow/5308944.cms>; accessed on 28 May 2019.
- United Nations Development Programme (UNDP). 2007. 'Fighting Climate Change: Human Solidarity in a Divided World', in *Human Development Report 2007/2008*. London: Palgrave Macmillan. Available at https://doi.org/10.1057/9780230598508_1.
- United Nations Framework Convention on Climate Change (UNFCCC). 1992. 'United Nations Framework Convention on Climate Change'. Available at <https://unfccc.int/resource/docs/convkp/conveng.pdf>.
- . 1995. 'Berlin Mandate', Decision 1/CP.1 in FCCC/1995/7/Add.1, 6 June.
- . 1997. 'Kyoto Protocol to the United Nations Framework Convention on Climate Change'. Available at <https://unfccc.int/resource/docs/convkp/kpeng.pdf>; accessed on 28 May 2019.
- . 2006. 'Dialogue on Long-Term Cooperative Action', Decision 1/CP.11 in FCCC/CP/2005/5/Add.1, 30 March.
- . 2008. 'Bali Action Plan', Decision 1/CP.13 in FCCC/CP/2007/6/Add.1, 14 March.

- _____. 2010. 'Copenhagen Accord', Decision 2/CP.15 in FCCC/CP/2009/11/Add.1, 30 March.
- _____. 2012. 'Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action', Decision 1/CP.17 in FCCC/CP/2011/9/Add.1, 15 March.
- _____. 2015. 'Lima Call for Climate Action', Decision 1/CP.20 in FCCC/CP/2014/10/Add.1, 2 February.
- Vihma, Antto. 2011. 'India and the Global Climate Governance: Between Principles and Pragmatism', *The Journal of Environment & Development*, 20(1): 69–94.
- World Meteorological Organization (WMO)/United Nations Environment Programme (UNEP). 1990. 'Report of the Ad Hoc Working Group Meeting of Government Representatives to Prepare for Negotiations on a Framework Convention on Climate Change', Geneva, 24–6 September.

Present at the Creation*

The Making of the Framework Convention on Climate Change

Chandrashekhar Dasgupta

Few major global agreements have been negotiated as expeditiously as the United Nations Framework Convention on Climate Change (UNFCCC). The negotiations commenced in February 1991 and were completed by May 1992, in time for the Convention to be opened for signature in the following month at the United Nations Conference on Environment and Development (UNCED) in

* This chapter is reprinted (with an updated postscript) with permission from Chandrashekhar Dasgupta. 2012. 'Present at the Creation: The Making of the Framework Convention on Climate Change', in Navroz K. Dubash (ed.), *A Handbook of Climate Change and India: Development, Politics and Governance*, pp. 89–98. New Delhi: Oxford University Press. For other more detailed accounts by the author of the negotiating history of the Convention, see Dasgupta (1994: 129–48; 2012).

Rio de Janeiro. It took only 15 months for the Intergovernmental Negotiating Committee (INC) to conclude this path-breaking agreement. By contrast, the Law of the Sea negotiations covered a full decade.

Initial Differences

This achievement is all the more remarkable since the initial positions of the parties were far apart. The negotiations reflected a deep North–South divide as well as major differences within both these groups.

In general, developing countries pressed for an agreement based on equity, reflecting the fact that anthropogenic climate change was the result of cumulative emissions of greenhouse gases (GHGs) originating mainly in the developed countries. The developed countries, on the other hand, sought to minimize the link between commitments under the agreement and responsibility for causing climate change. The United States (US) refused to recognize the link altogether, maintaining that countries should contribute to an international effort ‘in accordance with the means at their disposal and their capabilities’ (United States of America 1991), ignoring the question of responsibility for causing climate change.

India’s position was based on the principle that every human being had an equal right to the global atmospheric resource. As head of the Indian delegation, I stated our position as follows at the outset of substantive negotiations:

The problem of global warming is caused not by emissions of greenhouse gases as such but by *excessive levels* of per capita emissions of these gases. If per capita emissions of all countries had been on the same levels as those of the developing countries, the world would not today have faced the threat of global warming. It follows, therefore, that developed countries with high per capita emission levels of greenhouse gases are responsible for incremental global warming.

In these negotiations, the principle of equity should be the touchstone for judging any proposal. Those responsible for environmental degradation should also be responsible for taking corrective measures. Since developed countries with high per capita emissions of greenhouse gases are responsible for incremental global warming, it follows

that they have a corresponding obligation to take corrective action. Moreover, these are also the countries which have the greatest capacity to bear the burden. It is they who possess the financial resources and the technology needed for corrective action. This further reinforces their obligations regarding corrective action.¹

This statement introduced an Indian 'non-paper' setting out the full text of a draft framework convention (India 1991). The core provisions of the draft were incorporated in the article on 'commitments', which focused on the responsibilities of the developed countries. It set out the long-term objective of

stabilizing the concentration of greenhouse gases in the atmosphere ... on the basis of an equitable formula requiring, inter alia, that anthropogenic emissions of carbon dioxide from states should converge at a common per capita level, and which would take into account net carbon dioxide emissions during the century.

Towards this goal, the draft convention proposed that:

Developed country parties shall, as immediate measures: (a) declare, adopt and implement national strategies to stabilize and reduce their per capita emissions of greenhouse gases, particularly carbon dioxide; stabilization ... should be achieved by developed country parties at the latest by the year 2000 and should be set at 1990 emission levels, with the goal of achieving at least a (20%) (30%) (40%) (50%) reduction on these stabilized levels by the year 2005; (b) provide new and additional financial resources for developing country parties for the objective described in paragraph 4 below ...; (c) provide assured access to appropriate, environmentally sound technology on preferential and non-commercial terms to developing countries; and (d) to support developing countries in their efforts to create and develop their endogenous capacities in scientific and technological research and development directed at combating climate change.

¹ Statement by the leader of the Indian delegation, Second Session of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INCFCCC), Geneva, 19 June 1991. Copy on file with the author.

4. Developing countries may, in accordance with their national development plans, priorities and objectives, consider feasible measures with regard to climate change provided that the full incremental costs are met by provision of new and additional financial resources from the developed countries. (India 1991: 5)

Our proposals received wide support among developing countries. China, which had submitted a non-paper, calling upon the developed countries to assume the 'main responsibility' in addressing climate change, stated that the Indian non-paper to a large extent reflected the common views of many developing countries.

As already noted, the developed countries sought to minimize or ignore the link between responsibility for causing climate change and the burden of addressing the problem. They called upon developing countries also to accept some form of a binding mitigation commitment. Within this overall approach, however, there were significant differences of detail. Thus, Germany recognized that the developed countries have a special responsibility 'since these countries have been the main sources of the increase in atmospheric concentrations of climate-relevant gases', while also calling upon the developing countries to accept commitments because 'it is only with their broad participation that the global challenge can be met effectively' (Germany 1991). France, whose nuclear power plants met the bulk of its energy requirements, declared that it was prepared to limit its per capita emissions below 2 tonnes of carbon equivalent by 2000, provided other industrialized countries accepted the same commitment (France 1991). There were no takers for this offer among other developed countries. (In 1991–2, European Community [EC] policies were coordinated much more loosely than they are today.) At the other end of the scale, the US simply refused to recognize the question of historical responsibility.

The North and the South were divided not only on the nature of the commitments of the developing countries but also on the related question of financial and technological support. Developing countries, in general, refused to accept binding commitments, maintaining that their commitments would be conditional on receipt of finance and technology transfers from developed countries to cover the full incremental costs of response measures. The US rejected outright the demand for developed countries to assume financial commitments to

support mitigation and adaptation actions in developing countries. Other Organisation for Economic Co-operation and Development (OECD) countries were prepared to offer 'assistance' to developing countries to cover 'agreed' (as distinct from 'full') incremental costs, but this fell far short of the expectations of the South. The industrialized countries also rejected calls for technology transfer on anything other than commercial terms.

While maintaining a common front in insisting that the developing countries should assume binding mitigation commitments, the industrialized countries were deeply divided on the question of their own commitments. The EC proposed that industrialized countries should, in general, stabilize their emissions by the year 2000 at 1990 levels. Norway presented a similar proposal, calling for stabilization by OECD countries by the same date but at 1989 levels (Norway 1991).

The US opposed calls for such time-bound stabilization or reduction targets. It took the position that 'specific commitments for emissions reductions should not be included in the framework convention, because of the need for flexibility in nations' choices of their own measures' (United States of America 1991). Britain sought to find common ground between the EC and the US positions by calling for stabilization 'as soon as possible' (United Kingdom 1991).

Japan advocated a 'pledge and review' agreement, in which every country 'makes public a pledge, consisting of its past [*sic*] performance strategies' to limit emissions and targets or estimates of emissions resulting from these strategies. These would be subject to periodic reviews (Japan 1991).

Sweden urged all countries to limit GHG emissions on the basis of the best available technology and good practices. It prescribed a series of energy-efficiency measures for groups of countries selected on the basis of presumed ability to implement the commitments (Sweden 1991). This approach set aside questions of responsibility and equity.

As in the case of the North, there were significant differences also within the South. In particular, there was a major divergence between the positions of the countries whose economies were largely dependent on oil exports and the countries forming the Alliance of Small Island States (AOSIS). The oil exporters, led by Saudi Arabia,

were concerned about the potential impact of carbon mitigation measures on petroleum markets. They were opposed to ambitious mitigation commitments, even for the developed countries. On the other hand, the low-lying island states were deeply concerned about the possible submergence of their territories as a consequence of sea-level rise resulting from climate change. They, therefore, pressed for the strongest possible convention. India, China, and many other developing countries tried to steer a middle course in an effort to hold together the 'G77 and China' group.

Coalition Diplomacy

Both of the major groups—G77 and China and the OECD countries—made strenuous efforts to bridge internal differences. The developing countries tried hard to arrive at a common negotiating text. These efforts were partially successful. Agreement was reached within the group on the section on 'principles' (initially proposed by China). Reflecting our position on the conditional character of developing country commitments, G77 and China agreed that 'commitments that might be entered into by developing countries under this Convention are contractually dependent on the fulfilment of the financial and technology transfer obligations that must be entered into by developed countries who are in the main responsible for the urgency of the present situation.' Agreement was also reached on the need for 'adequate, new and additional resources' and technology transfer to developing countries on 'favourable, concessionary and preferential terms'. However, differences persisted on a number of issues, including the question of the admissibility of reviews in regard to developing countries. Most importantly, there was no agreement within the group on the crucial question of specific emission reduction commitments for developed countries because of the wide differences between AOSIS and the oil-exporting countries.

By the end of 1991, it became clear that G77 and China would not be in a position to reach a consensus text on commitments. Our proposals would have to be advanced through a more compact group. Accordingly, at the year end, India joined hands with 53 other developing countries (including China) to submit a common text on 'commitments' (United Nations General Assembly 1991). The

text called on the developed countries, on the basis of assessed contributions, to 'provide on a grant basis new, adequate and additional financial resources to meet the full incremental costs of developing country Parties' in connection with mitigation and adaptation measures. It incorporated the demand of the developing countries for technology transfer on 'concessional, preferential and most favourable terms'. Developing countries would be required 'in accordance with their national development plans, priorities, objectives and specific country conditions to consider taking feasible measures to address climate change, provided that the full incremental costs' are met by the developed countries. They might also, on a strictly voluntary basis, take additional nationally determined measures.

The OECD countries were initially less successful in forging a common position. The EC made an early attempt to reach such a consensus on the basis of the Japanese proposal for a 'pledge and review' agreement. In June 1991, the EC proposed that the Convention 'should include what has come to be called a pledge and review proposal', pointing to the need for 'flexibility' (a crucial concern for the US). Its own proposal for a time-bound emission stabilization commitment for developed countries was now described as being merely 'an example of a commitment that should preferably be embodied in a protocol.'²

The new EC approach came under fire not only from the developing countries but also, very importantly, the non-governmental organization (NGO) community. Developing countries pointed out that the new statement diluted the specific commitments of the developed countries and unfairly imposed binding obligations on the developing countries. Moreover, in the absence of agreed criteria and guidelines, a review could only be an arbitrary exercise. The NGO newsletter, *ECO*, launched a devastating attack on 'pledge and review', describing it as 'hedge and retreat' proposal.

Coming under strong attack, the EC beat a hasty retreat. In the next session, held in September 1991, it recognized that the 'concept of Pledge and Review had caused a great deal of confusion. We are

² Intervention by the Netherlands delegation on behalf of the European Community and its Member States, Second Session of the INCFCCC, Geneva, 28 June 1991. Copy on file with the author.

quite ready to admit that this was also the case among Member States of the European Community. The Group of 77 was, therefore, completely right when it stated, through its Chairman, that the concept of pledge and review lacked precision and transparency.’³

The OECD countries then attempted to arrive at a common text on the basis of the EC stabilization proposal. There was some movement on the part of Japan, Canada, Australia, and others but positions remained far apart. The US rejected any stabilization target. The final outcome of the negotiations between the OECD countries was a heavily bracketed text on stabilization and no less than four alternative formulations! The EC expressed its ‘regret that the positions reflected in the document are as far apart as is the case’ (ECO 1992b).

Impasse

Thus, as late as in December 1991, the INC deliberations had a trilateral character. Most OECD countries, led by the EC, sought an agreement with commitments for all parties, including time-bound emission stabilization targets for all developed countries. The US wanted a very general agreement focused on further scientific studies on climate change; it refused to accept time-bound emission reduction—or even stabilization—targets, or any obligation to provide financial resources, or to transfer technology to the developing countries on anything other than commercial terms. The developing countries—in particular, the 54 countries presenting a common negotiating text—called upon the developed countries to commit themselves not only to emission limitation targets but also to provide financial resources to developing countries and transfer technology to these countries on preferential terms. They emphasized that any obligations they assumed would be conditional on receipt of adequate financial and technological support from the developed countries.

³ Intervention by the Netherlands on behalf of the European Community and its Member States, Third Session of the INC/FCCC, Nairobi, September 1991. Copy on file with the author.

The 'negotiations' took the form of a drafting exercise, with hardly any attempt at resolving substantive differences through bargaining. The net result by the end of the penultimate session in December 1991 was a 'consolidated working document' in which all the core provisions—covering the sections on 'Principles', 'General Commitments', 'Specific Commitments', and 'Special Situations'—were placed within square brackets, reflecting divergent views. In fact, only a single word in these sections was unqualified by a bracket—the word 'commitments' figuring as a title!

We drew a blank in our efforts to sound the EC and the US separately on the possibility of a deal. I came to the conclusion that neither of these parties was prepared to enter into substantive negotiations with the developing countries until they succeeded in forging a common position between themselves. (As noted earlier, the attempt to resolve differences within the OECD came to naught in the December 1991 session.) The result was a deadlock in the INC.

The fifth and final session of the negotiations opened in New York in February 1992, with only four months remaining for the Rio de Janeiro Summit on Environment and Development. But little progress could be achieved even at the February meeting.⁴

The original plan was to complete negotiations on the framework convention by the fifth session of the INC in February 1992. However, in view of the impasse in the negotiations, the INC decided to resort to a typical United Nations (UN) device. It was decided to 'resume' the fifth session in May, in the hope of a breakthrough.

Breakthrough

In my report to New Delhi on the outcome of the February meeting, I ventured the following assessment:

At the present moment the prospects of a successful conclusion of the negotiations in May are not promising. Nevertheless, it is possible that a last minute effort will be made to bridge the differences between the US and the EC by adoption of an ambiguous formulation concerning

⁴ For details of the limited outcome of the February meeting, see Dasgupta (1994: 141–2).

stabilisation and reduction of emissions of developed countries. This could be the basis of an attempt to shift the balance of responsibility from the North to the South. Our delegation would have to be prepared for this eventuality.

In May, an agreement of sorts was finally reached between the EC and the US. This was the result of a last-minute British initiative to bridge the divide. Anglo-US talks in Washington produced a formulation on the mitigation commitments of the developed countries. This was riddled with ambiguities concealing the substantive differences between the US and EC positions. The EC Environment Commissioner initially rejected the formulation as 'completely unacceptable', but member countries finally accepted it with minor amendments (Bodansky 1993: 491). Thereupon, the US-EC draft was incorporated verbatim in a 'Chairman's text' presented at the beginning of the 'resumed' fifth session in May.

When the text was debated in plenary, Philippines, on behalf of G77 and China, sought clarification on no fewer than fifteen obscure points in the formulation. Supporting the G77 position, I pointed out the artful ambiguity of the formulation, describing it as legal 'striptease'. In response to my intervention, the Chairman acknowledged that the ambiguity reflected lack of agreement between the industrialized countries (*ECO* 1992a).

The Chairman's text was weighted in favour of the developed countries. In keeping with the EC position, all countries would be required to 'coordinate' their economic and administrative instruments in the context of a climate change response, in order to avoid so-called 'distortions' in international trade. Financial support to developed countries would cover only 'agreed', not 'full', incremental costs. In a partial concession to the South, the term 'review' was eschewed in relation to the developing countries but these countries were asked to link proposals for financial support with their 'national communications'. This opened the possibility for reviews of policies and measures reported by developing countries in their 'national communications'. Above all, the chair sought to treat as sacrosanct the US-EC text on commitments of the developed countries, insisting that reopening the issue would inevitably lead to the collapse of the negotiations.

On the chair's suggestion, negotiations were largely confined within an 'enlarged bureau', which included, in addition to members of the bureau, countries which he regarded as 'key' players. In response to the chair's position on the non-negotiable nature of the US-EC text on the mitigation commitments of the developed countries, we insisted that the chair's text as a whole was under negotiation, reserving our right to press for an amendment on the US-EC formulation.

Vigorous negotiations ensued in the 'enlarged bureau' (Dasgupta 2012). One of our earlier successes in the session was an agreement on provision of financial resources to developing countries to cover the 'agreed full incremental costs'. Coordination of economic and administrative instruments was limited exclusively to developed countries. It took much longer to secure acceptance of our position on the inadmissibility of reviews of developing country actions. A 'review' implies a binding commitment and is, therefore, inapplicable in respect of actions that are purely voluntary. We were prepared to communicate information about our national policies and measures but only for the purpose of estimating global trends, not a review of these policies and measures. We were finally able to exclude all references to a review of the voluntary actions of developing countries.

Perhaps the most difficult negotiations concerned a paragraph drafted by us. This read as follows in its final form:

The extent to which developing country parties will effectively implement their commitments under the Convention will depend upon the effective implementation by developed country parties of their commitments under the Convention related to financial resources and transfer of technology and will take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties.

We were able to secure agreement on this crucial paragraph only after very hard and protracted negotiation. It stands as Article 4, paragraph 7, of the Convention.

Thus, the Framework Convention conforms to our basic position concerning the voluntary and non-negotiable nature of the actions taken by the developing countries without international support. Developing countries have no obligation to implement mitigation

measures involving incremental costs, unless these costs are met in full by the developed countries. When thus supported, developing countries assume a contractual or conditional commitment but unlike the binding commitments of the developed countries.

However, there was an unfinished task at the conclusion of the negotiations. The US–EC formulation incorporated in the Convention as Article 4.2(a) and (b) failed to specify time-bound emission reduction targets for the developed countries. The Kyoto Protocol (KP), adopted in December 1997, filled this lacuna.

Postscript: From Rio to Paris⁵

The climate change convention adopted in 1992 Rio de Janeiro was a framework agreement. It did not spell out time-bound emission reduction targets for each developed country after 2000. This lacuna was filled by the KP adopted in 1997.

In addition to specifying quantitative emission limitation and reduction objective (QELRO) targets for each developed country party, the KP also introduced the innovative Clean Development Mechanism (CDM). This enabled enterprises in a developed country to meet a part of their emission reduction targets by meeting the costs of emission limitation measures in developing countries. Thus, the KP provided for mitigation measures in both developed and developing countries, through commitments by developed countries with a historical responsibility for precipitating climate change.

The KP satisfied the criterion of equity, being based on the principle of ‘common but differentiated responsibility’. It met the criterion of efficiency since it enabled developed countries to meet emission reduction targets cost-effectively through mitigation actions in other countries. It also had the potential of satisfying the criterion of adequacy. However deep the emission reductions required by a climate stabilization goal, these could be achieved flexibly through mitigation actions anywhere, provided the QELRO commitments of developed countries were sufficiently ambitious. The UNFCCC and

⁵ This postscript is additional text that has been added to this reprint of the original article.

the KP provide for emission limitation actions in developing countries as well, through the Global Environment Facility (GEF) and the CDM. The potential for such actions is unlimited—provided that the incremental costs involved are met by developed countries. The financial burden of mitigation would be shouldered by developed countries on the basis of their differentiated responsibilities, including their historical responsibility.

This extremely heavy burden was, of course, politically unacceptable to developed countries, which were left with two possible options. They could continue to make modest contributions under the KP while paying ritual obeisance to the principle of common but differentiated responsibilities, or they could seek a new agreement that would erode the centrality of the principle.

In the event, the developed countries chose the latter alternative. Their choice was largely determined by a tectonic shift in the balance of global economic power. In the 1990s, the OECD countries were the unchallenged leaders of the global economy. In the new millennium, however, the dramatic rise of China, followed at some distance by other large economies such as India and Brazil, raised deep competitive concerns in the developed countries. There was a growing reluctance to accept a climate regime that imposed mitigation costs on their industries but not on their rivals in developing countries. These concerns initially prompted proposals for countervailing border levies on carbon-intensive imports from developing countries, but this raised questions of compatibility with the World Trade Organization (WTO) regime. The alternative course of negotiating a new climate change regime found increasing favour in the developed countries.

The end result was the Paris Agreement (2015), which does away with mandatory, time-bound emission reduction commitments for developed countries. It calls on every country to make a Nationally Determined Contribution (NDC), while shifting the emphasis from the ‘principle of common but differentiated responsibilities and respective capacities’ to a vaguely defined ‘national circumstances’ as a basis of differentiation. In essence, the Paris Agreement is a ‘pledge and review’ agreement, not unlike the Japanese proposal of 1991 which, as we saw, was rejected at the time as inadequate. The climate change negotiations have turned a full circle.

References

- Bodansky, Dan. 1993. 'The United Nations Framework Convention on Climate Change: A Commentary', *Yale Journal of International Law*, 18(2): 451–558, available at <https://digitalcommons.law.yale.edu/yjil/vol18/iss2/2>.
- Dasgupta, Chandrashekhar. 1994. 'The Climate Change Negotiations', in I.M. Mintzer and J.A. Leonard (eds), *Negotiating Climate Change: The Inside Story of the Rio Convention*, pp. 129–47. Cambridge: Cambridge University Press.
- . 2012. 'Negotiating the Framework Convention on Climate Change: A Memoir', in K.V. Rajan (ed.), *The Ambassadors' Club*, pp. 61–84. New Delhi: HarperCollins.
- ECO. 1992a. *NGO Newsletter*, 5 May.
- . 1992b. 'Statement by Portugal on Behalf of the European Community and Its Member States', *ECO*, 28 February.
- France. 1991. 'Suggestions Concerning the Limitation of Greenhouse Gases', in Intergovernmental Negotiation Committee for a Framework Convention on Climate Change (INCFCCC), *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.1, pp. 10–14.
- Germany. 1991. 'Non Paper: Important Elements for an International Climate Convention', in INCFCCC, *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.1, pp. 15–23.
- India. 1991. 'Non Paper: Draft Framework Convention on Climate Change', in INCFCCC, *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.3, pp. 3–17.
- Japan. 1991. 'Informal Paper: Pledge and Review Process as a Possible Mechanism to Implement Commitments Defined on the Basis of the Convention', in INCFCCC, *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.7, pp. 3–5.
- Norway. 1991. 'Norwegian Non Paper', in INCFCCC, *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.2, pp. 10–31.
- Sweden. 1991. 'Non Paper: Commitments in Chapter IV.1 (submitted on 19 June 1991)', in INCFCCC, *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.6, pp. 3–5.
- United Kingdom. 1991. 'Draft Paper: Possible Elements for Inclusion in a Framework Convention on Climate Change', in INCFCCC, *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.1, pp. 83–8.

United Nations General Assembly. 1991. 'Draft Report of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change on the Work of Its Second Session held at Geneva from 19 to 28 June 1991', A/AC.237/WG 1/L.7.

United States of America. 1991. 'Submission of the United States to the Intergovernmental Negotiating Committee on Climate Change', in INFCCC, *Preparation of a Framework Convention on Climate Change*, A/AC.237/Misc.1/Add.1, pp. 89–95.

One Long Day in Copenhagen*

Shyam Saran

At the Copenhagen Climate Summit, no country could set aside its selfish interests to set up a robust framework for global collaboration to deal with the elemental threat staring humanity in the face. Neither the developed industrialized countries nor developing countries like India were able to rise above their narrowly defined and near-term interests. Instead, the negotiations had a competitive dynamic, each country yielding as little as possible and extracting the maximum. It was inevitable that this would lead to a least-common-denominator outcome, and that is what happened with the Copenhagen Accord (United Nations Framework Convention on Climate Change [UNFCCC] 2010). ...

En route to the airport, I received a call from the Prime Minister's Office (PMO) telling me that the Chinese premier, Wen Jiabao, had requested a meeting with him on the sidelines of the summit. ...

* This chapter is reprinted with permission from Shyam Saran. 2017. *How India Sees the World: From Kautilya to the 21st Century*. New Delhi: Juggernaut.

When he asked for my views before a response was conveyed to the Chinese, my instant reaction was that he should agree. ...

I insisted on the meeting because of the recent strains in India–China relations. There had been incidents at the border and the Chinese had reacted negatively, even threateningly, to the tour of Arunachal Pradesh by His Holiness, the Dalai Lama as well as to our prime minister's own visit to the state later in the year. The proposed meeting in Copenhagen, I felt, would help in reducing some of the prevailing tensions. It would also strengthen coordination among Brazil, South Africa, India, and China—the BASIC group—at the climate summit. ...

Soon after the flight took off, Foreign Secretary Nirupama Rao and I were summoned to the prime minister's cabin. He was not enthusiastic about meeting Wen Jiabao and was apprehensive that contentious issues like Tibet would be raised. ... My own feeling was that the Chinese premier wanted India's support, as a member of the BASIC group, against what was turning out to be a concerted effort by the United States (US) and its Western allies to isolate China at the climate summit.

This was a big change from our experience of the previous two years, when China was projected as the poster boy for tackling climate change, while India was pilloried for being 'recalcitrant' and 'obstructionist'. The irony was that the Chinese were often taking more hard-line positions than we were in the negotiations. ...

One witnessed a change in the West's attitude towards China soon after Obama's first official visit to China as US president in November 2009. Instead of inaugurating what the Americans believed would be a new era of 'strategic trust' and cooperation between the established and the rising power, the Chinese treated the visitor as a supplicant. ...

American eagerness to construct a positive narrative of US–China relations may have led the Chinese to believe that the US was in a weak and vulnerable position and that this was China's opportunity to press its advantage politically and psychologically. But the Chinese had made a miscalculation, and US anger surfaced soon afterwards, in the run-up to Copenhagen. And it had its impact on Indo-US relations too.

Prime Minister Manmohan Singh visited Washington later that same November, shortly after Obama's China visit. Much pomp and

ceremony surrounded the visit, intended to assuage Indian concerns over the growing alignment in US–China relations. The special attention shown to our prime minister was in the nature of a consolation prize. Behind the scenes, the new US administration did not accord India the same priority as the previous one. ... There was, moreover, considerable unhappiness at the inclusion of a paragraph about South Asia in the US–China joint statement (Administration of Barack Obama 2009: 1707):

The two sides are ready to strengthen communications, dialogue and cooperation on issues related to South Asia and work together to promote peace, stability and development in the region.

During the preparations for the Indian prime minister's visit to Washington, the US side also played hardball, insisting that India align its negotiating position at Copenhagen with the US, believing perhaps that China would drift away from BASIC. There was a video conference on 11 November between Obama's chief economic advisor of the time, Lawrence Summers, and his climate envoy, Todd Stern, on the US side and Planning Commission deputy chairman, Montek Singh Ahluwalia, and myself on the Indian side. Summers adopted an overbearing and threatening tone, virtually demanding India's alignment with the American position and a reflection of this in the joint statement. My suggestion that we should only have a general statement committing the two countries to work for a successful outcome at Copenhagen was summarily rejected.

But the prime minister's Washington visit turned out to be more substantive and positive than expected, thanks to the Chinese overplaying their cards. Much of the visit was devoted to an exchange of notes on the China challenge.

This must not have gone unnoticed in Beijing, and the request for a meeting between the two leaders at Copenhagen was probably related to this change in the geopolitical equation. Also, rightly or wrongly, the Chinese were worried at what they saw as a shift in the Indian position on climate change indicated by recent statements from India's environment minister, Jairam Ramesh, who had sought to introduce a degree of flexibility in India's negotiating brief.

Our delegation arrived in Copenhagen on the evening of 17 December, and Jairam Ramesh reached the hotel to brief the prime minister on the results of the ministerial segment he had been attending. The Danish chairman had circulated a draft of the Copenhagen declaration, which would be in the nature of a political declaration, and this was to be discussed at an informal meeting that same night among a Friends of the Chair group of twenty to twenty-five leaders. ...

A draft of the possible outcome document was circulated and was then considered paragraph by paragraph. The formulations deviated substantially from the BASIC group's positions. While there was consensus on limiting global temperature rise to 2°C, the European countries also wanted to include a target of reducing global greenhouse gas (GHG) emissions by 50 per cent by 2050. This was accompanied by an offer from the developed countries to reduce their own emissions by 80 per cent by the same date. The implicit assumption was that the developing countries would also have to achieve absolute reductions in their emissions by at least 20–5 per cent by that date to meet the 50 per cent reduction target for global emissions.

China, Brazil, and India, predictably, opposed this proposal. There was a sharp reaction from the European countries. They alleged that this opposition could jeopardize the interests of other developing countries for which the developed world was ready to provide US\$100 billion in climate-related finance by 2020. At one stage, Jairam Ramesh suggested that the 50 per cent target could be included so long as it was linked to the equity principle. But this was categorically rejected by the Chinese delegate. By now we knew that without its substantive content being spelt out, equity would be a mere slogan.

The Europeans then suggested that while the global goal of 50 per cent reduction in global emissions could be omitted, there should continue to be a reference to the developed countries' commitment to reduce their own emissions by 80 per cent by 2050. This too was opposed by the Chinese, who argued that inclusion of this target, along with the 2°C temperature limit, would again imply that the balance reductions would have to come from developing countries. There was a storm of protest from the Western leaders.

Another controversy erupted over the treatment of voluntary mitigation actions by developing countries. This was sought to be put in the same category of commitments as those of the developed countries and subjected to some form of international verification. This would have blurred the distinction between developed and developing countries, whose obligations are as different as their entitlements in the UNFCCC.

The final controversy was over the legal nature of the 'agreed outcome'. The Western countries wanted a specific reference to a legally binding outcome. India and other BASIC countries insisted that the nature of the outcome be determined by the content of the agreement and not be prejudged.

The discussions were still in progress when I left to cover our prime minister's meeting with his Chinese counterpart at 8 a.m. at the hotel. ...

Wen Jiabao welcomed the prime minister, saying he regarded Dr Singh as his 'guru' and a wise elder brother. He said he wanted to acquaint the prime minister with the very disturbing developments that had been taking place over the 24 hours he had been in Copenhagen. The US and the West European countries had been working conspiratorially to cook up an outcome behind China's back. He had not been invited by the Danish chairman to the informal Friends of the Chair meeting (convened by the chairman) after the formal banquet the previous night. His vice foreign minister, He Yafei, had gone instead. It had been reported to him that the Danish draft was completely against the consistent positions held by the BASIC group. Wen requested our prime minister to extend support to China against this well-orchestrated Western attempt to undermine the UNFCCC and to openly attack the interests of developing countries.

Our prime minister suggested that the leaders of the BASIC group meet informally before the plenary to coordinate their positions, and Wen Jiabao welcomed the suggestion.

There followed an interesting exchange on India-China relations. Wen recalled that during his visit to India in April 2005, the two leaders had agreed to a strategic and cooperative partnership, and that their bilateral relations had acquired a global dimension. India-China cooperation was necessary to safeguard their respective

interests as well as the interests of developing countries on several global and regional issues. The Chinese premier added that China would never harm India's interests and recognized India's leadership role in South Asia.

Then he made an extraordinary assertion. He acknowledged that his 'Indian friends' had been unhappy with the reference to South Asia in the China-US joint statement issued after Obama's visit to Beijing in November (from which I have quoted above). He said he wanted to clarify that the formulation was not China's but put there by the US side! He again emphasized that China would not interfere in South Asia and harm India's interests.

Whether this was true or not, it certainly put India-China relations thereafter on an even keel for a period, and Wen made a successful visit to India later in 2010. ...

Just before the plenary began, the BASIC leaders—Premier Wen, President Lula of Brazil, President Zuma of South Africa, and our own prime minister—met in the delegates' lounge. This was the very first such meeting of the BASIC leaders. In the brief exchange, each of the leaders criticized the conduct of the Western countries and the partisan role played by the Danish chair. They deplored the attempts to create a division between the developing countries and the BASIC countries. More importantly, they agreed that their negotiators would work in close consultation and coordination, holding firmly to the well-known BASIC positions on outstanding issues. They also agreed that the leaders should not be expected to engage in negotiating the outcome draft. ...

Meanwhile, the Friends of the Chair had completed the first reading of the draft put forward by the Danish hosts. There had been no consensus and the chairman had agreed to prepare a fresh draft for consideration, taking into account the deliberations held in the early hours of that morning. ...

Jairam Ramesh had apparently been engaging in consultations with several of the leaders and their aides. When we reassembled, he handed me the fresh draft document and requested me to handle the negotiations as he had to meet and brief our prime minister. The draft was deeply problematic, and I pointed out to him that several of the formulations would be unacceptable to the BASIC group. He said that nothing had been agreed in the informal consultations and everything

was ad referendum. I could seek amendments as we deemed fit. For the rest of the session, it was Ambassador Chandrashekhar Dasgupta and I who engaged in what proved to be difficult, unpleasant, and acrimonious negotiations.

The points of contention were no different from those raised in the morning session. The goal of 50 per cent reduction in global emissions was retained, along with the 2°C temperature rise limit. I immediately objected to it. Gordon Brown accused the Indian delegation of bad faith, insisting that Jairam Ramesh had agreed to the formulation in the morning. Merkel also chimed in, saying that positions agreed in consultations among leaders should be respected.

I explained that the 50 per cent target carried the implicit assumption of substantial emission reductions by developing countries without any indication of the financial resources and technology transfers necessary to enable such mitigation action by them. I also pointed out that such expectations were in complete contradiction to the overriding objective of poverty eradication and social and economic development, which was recognized without qualification in the UNFCCC.

Once again, as they had in the morning session, the West Europeans insisted that along with the 2°C temperature rise limit, the commitment of developed countries to reduce their own emissions by 80 per cent by 2050 should be recorded in the document. I had to point out that this would not be acceptable for the same reason, that is, it implied that the developing countries would have to contribute the balance of absolute emission reductions required to attain the global temperature goal; they could not take on this commitment without a clear and definitive indication of the financial and technological resources available to them under the proposed climate regime.

Subsequently, I had to repeat these arguments for President Obama, who came in later and demanded to know why India was saying no to every proposal without offering any alternative. After hearing me out, he said he understood our position but could not agree with it.

The discussion then moved on to the issue of transparency. Obama insisted that the voluntary mitigation actions by developing

countries should be in accordance with international guidelines and subjected to international evaluation. While developed and developing countries may have differential commitments, the same legal template should apply to all.

Here, again, I had to point out that the obligations and entitlements of developed and developing countries were clearly differentiated in the UNFCCC. This was the essence of the principle of common but differentiated responsibilities and respective capabilities, or the so-called CBDR principle, enshrined in the agreement. I added that developing countries were ready to use their already existing responsibility to provide details of their climate action as part of their National Communications (NATCOMs). This could be made more detailed and more frequent, but it was not the same as the evaluation of absolute emission reduction obligations of developed countries.

This set off another storm in the room, with Sarkozy accusing India and the 'emerging big countries' of indulging in a charade. He went on to threaten to expose the obstructions posed by them, adding that if agreement could not be reached on the global goal and transparency, no money would be available for poorer countries. He added for good measure that it was because of these 'big countries' that the Maldives and Bangladesh would be deprived of the money they would otherwise have received from developed countries.

There was a subsequent discussion on finance. The Mexican president proposed a Green Climate Fund, which could be subscribed to ... on the basis of accepted criteria. There were some queries about whether major developing countries would also contribute funds. I pointed out that it was the legal responsibility of the developed countries to provide both finance and technology to developing countries to enable them to undertake climate action. Developing countries had no such obligation. This was greeted by much smirking among Obama, Gordon Brown, and Sarkozy.

It was during this session that the developed countries agreed to provide US\$10 billion a year for three years, from 2010 to 2012, to the least developed countries (LDCs), Small Island Developing States (SIDS), and African states. A firm commitment from the developed countries to provide US\$100 billion by 2020 was shot down by Obama, who said that the term used should be 'mobilize' rather than

‘provide’. He said he could not make a firm commitment without US congressional approval.

When Ambassador Chandrashekhar Dasgupta was occupying the Indian chair and taking part in the drafting, Sarkozy, at one point, shouted that leaders should not have to negotiate with ‘junior officials’. Ambassador Dasgupta reacted strongly to this, pointing out that he was representing India and his credentials should not be questioned. Sarkozy did subside after this, apologizing for his remark.

I left the negotiating room soon afterwards to brief the prime minister, and also to prepare for our departure that evening for Delhi. It was already past five in the evening, and it seemed unlikely that an agreement would be reached in time for a closing plenary, when we received a message that Wen Jiabao was requesting an urgent meeting with our prime minister. He had also invited the other BASIC leaders to the meeting to take stock of the day’s deliberations. ...

Wen Jiabao welcomed his fellow leaders and said he wanted to discuss the manner in which BASIC should handle the impending failure of the summit, which the developed countries would squarely blame on the BASIC countries. He suggested a coordinated strategy to deal with the negative fallout. He also said the US president had asked to see him before his departure, and the meeting with him had been set for 7 p.m. So, he also wanted advice on what he should convey to the US president.

An inconclusive discussion followed on what the BASIC leaders should say about the summit. It was agreed that while regretting the failure of the summit, a commitment to continuing the negotiations should be conveyed to the international community. It was also agreed that BASIC needed to strengthen their consultations and coordination in the negotiating process. The leaders agreed with the positions taken by their negotiators in the Friends of the Chair meeting. Wen was asked to convey all these points to the US president.

It was at this juncture that President Obama arrived at the glass door of the conference room, accompanied by Hillary Clinton and other senior aides. The deputy National Security Advisor (NSA) for economic affairs, and later the US trade representative, Mike Froman was there, as was Todd Stern, the US special envoy on climate change.

Obama called out to Wen Jiabao from the door, asking whether he should come in or wait for the meeting to conclude. Wen Jiabao looked questioningly at his counterparts, who readily agreed to invite the US president to join the discussions. Obama was invited to sit next to Zuma. The room had become very crowded, and several accompanying aides had to stand.

The US president began by saying that a failure of the Copenhagen summit would be a very serious setback and every effort should be made to salvage it. He said most of the proposed Copenhagen Accord had been agreed on except for the impasse on a few remaining issues. For the US, the issue of international review of mitigation actions undertaken by developed and developing countries was most important, he said. For him to persuade the US Congress to approve significant financing for developing countries, the transparency of action taken by all parties was crucial. He conveyed that if acceptable language could be found on this issue, then the accord could be saved. If not, he was prepared to go ahead with an agreement with those willing to join the accord. The rest would have to explain to the world why they were standing outside the agreement.

Wen Jiabao conveyed the willingness of the BASIC countries to record their voluntary actions in their respective NATCOMs, which could meet the transparency objective. However, Obama said this would not be sufficient. He suggested an attempt be made to find some acceptable language. He asked Mike Froman to consult with the representatives of the BASIC leaders to see if a compromise could be reached. Froman was joined by He Yafei from China, Jairam Ramesh from India, Luiz from Brazil, and Alf Wills from South Africa. They went into a huddle in a corner of the room while the leaders continued to discuss other issues. After about ten minutes, the group returned with the formulation 'technical analysis and assessment' as applicable to developing country mitigation actions to meet the transparency criterion.

Obama was not satisfied with the wording and wanted a stronger, more explicit, formulation. After some further back and forth, he suggested the phrase 'international analysis and assessment', but the Chinese looked sceptical. At this point, Jairam proposed 'international consultations and analysis', which Obama seemed inclined to

accept. He turned to Wen Jiabao to ask whether the latest formulation would be acceptable to China. Wen Jiabao, in turn, looked around to see if the others had any reservations. When the other leaders kept their counsel, he nodded his head in assent.

It was at this point that all hell broke loose. Xie Zhenhua, China's chief climate negotiator, who had been following the exchange with increasing distress, got extremely agitated and began to loudly and angrily berate his own premier. Since I knew Mandarin, I could broadly follow what he was saying. Xie wagged his finger at Obama, exclaiming that the American president had brought nothing to the table and was making outrageous demands on China. He then banged the table with his fist and warned his premier against accepting any compromise that would be akin to selling out the country. Obama asked Wen Jiabao's interpreter to translate what Xie was saying. She was extremely flustered and said she could not translate what had been said. Wen Jiabao sat impassively and did not retract his acceptance of the compromise formulation.

Xie's outburst was most unusual and unexpected. For an official to angrily disagree with his own premier in public would be unthinkable in any country, and more so in an authoritarian and strictly hierarchical system like China's. However, Xie continues to serve as China's chief climate change negotiator to this day and does not seem to have been taken to task for his public outburst at his premier at Copenhagen.

Having pocketed what he had been looking for, Obama proceeded to sell his European allies down the drain. He agreed to have all references to the 50 per cent reduction in global emissions dropped from the final draft outcome document as well as the reference to the developed countries' commitment to 80 per cent emission reduction by 2050. He also agreed that there need not be any reference to a legally binding outcome that the European countries had been insisting upon. He then left to consult with his allies still waiting in the main negotiating room. After about twenty minutes, he emerged to announce to the gaggle of American and international press: 'We have a deal.'

For a leader representing a country that had brought nothing to the negotiating table, this was indeed a public relations coup. The Europeans were given no opportunity to demur.

Earlier when we were exiting the small conference room after Obama's departure, Xie Zhenhua, whom I had worked with closely during the past two years, came up to me, held my hand and declared with barely concealed frustration: 'The UNFCCC and the Kyoto Protocol have been buried at this meeting and we will learn to regret this day.'

The process of attrition and systematic hollowing out of the UNFCCC had begun. The Paris Agreement of 2015 represents the culmination of the dismantling exercise. And India dare not acknowledge that it has been complicit in it.

References

- Administration of Barack Obama. 2009. 'Joint Statement by the United States of America and the Republic of China', 17 November. Available at <https://www.gpo.gov/fdsys/pkg/PPP-2009-book2/pdf/PPP-2009-book2-doc-pg1702.pdf>.
- United Nations Framework Convention on Climate Change (UNFCCC). 2010. 'The Copenhagen Accord', Decision 2/CP.15, FCCC/CP/2009/11/Add.1, p. 4.

Reaching Agreement in Paris

A Negotiator's Perspective

Ashok Lavasa

The Context for Negotiations

Paris marked a high point in the climate change dialogue in its chequered history of over two decades. Few issues concerning the future of humankind have seen so much global concern and conflict. While the world continued to witness the ill effects of climate change, international negotiations continued to be dogged by the politics of a divided world. There were protocols that were signed but not adopted, and there were promises that were made but not kept. Climate change had divided the world between those who had polluted and those who were being asked to foot the bill. While the developed countries were keen to arrest the current levels of emissions of the developing countries, the latter were struggling to reconcile the new expectations and their financial burden with the burden of development. The backdrop of Paris was dark, the prospects hazy, but the expectations high. However, what characterized the Paris Agreement on 12 December

2015 was a collective sigh of relief and a near-unanimous sense of achievement.

How did this happen? Was it a silent determination on the part of divergent groups to agree to a common agenda for the future? Was it an overwhelming commitment on the part of the host country, France, to be the coryphaeus of a new order that would deal with the challenge of climate change? Was it a victory the European Union (EU) wanted to claim? Was it desperation on the part of the United States (US) that was trying to present Obama and the Democrats as the saviours of humankind, an image that would see them through the hustings of 2016? Was it a collective desire to demonstrate a consensus even if it meant a weak Agreement? Was it sheer ennui?

The fact that the spotlight was on India was evident during the build-up to Paris. Speaking to the *Financial Times* four weeks before the negotiations began, the then US secretary of state, John Kerry, warned that India could be a ‘challenge’ at the upcoming climate talks in Paris, with its government reluctant to accept more of a role in addressing global warming. ‘We’ve got a lot of focus on India right now to try to bring them along’, Kerry said (Sevastopulo and Clark 2015). Kerry was clearly trying to build on India’s past reputation of being an obdurate negotiator and creating unwarranted apprehension about India with the intention of putting it on the back foot. The battle had begun.

The immediate trigger was a rather piquant face-off between the Indian Minister of State for Environment, Forest and Climate Change Prakash Javadekar and the US Chief Negotiator Todd Stern, at the pre-Conference of the Parties (COP) meeting at Paris on 9 November. In his concluding remarks, the US chief negotiator called for an ambitious Paris Agreement rather than being ‘minimalistic’. In turn, the Indian minister concluded by saying that Paris should aim at the ‘doable’, as Paris might not be able to solve all problems and some issues could be resolved later. He then looked at the US flag and added with the glee of a goalkeeper who had just saved a penalty stroke, ‘and that is not minimalistic’.

That set the tone for the subsequent bilateral meeting between India and the US. The US side was up to its familiar argument about the changing world and economic circumstances that the Agreement must recognize. This, as per the US viewpoint, would mean sharing

the responsibility of reducing emissions and providing finance by developing and developed countries in equal measure, rather than the burden being recognized as the sole responsibility of the developed countries, which was the case hitherto. The Indian side brushed aside the US suggestions by saying that the United Nations Framework Convention on Climate Change (UNFCCC) could not be rewritten in Paris.

Ten days later, at the G20 Summit at Antalya, there was a prolonged discussion on para 24 of the Summit statement dealing with climate change. The Indian sherpa held out till the wee hours of the morning and compelled the developed countries to settle for a goal-less draw. The para reflected conventional positions except that, at the insistence of the US, it was added that the leaders would instruct their negotiators to show greater 'flexibility' while negotiating the Paris Agreement. The situation was complicated by the fact that India's traditional ally at climate change talks, China, had announced in a joint statement with the US in 2014 that its carbon dioxide emissions would peak by 2030 (Office of the Press Secretary 2014) and had won plaudits for its noble intent. Here were the biggest historical contributor, the US, and the biggest contemporary contributor, China, joining hands and taking credit for being leaders of a better future. In fact, China had secured anticipatory bail for its emissions that would continue to rise for 15 years and then peak at undefined levels. This triggered expectations that India would similarly declare its holy commitment, leading to a debate within the country on whether it should fall in this trap or steer clear.

Throughout 2014 and the following year, India resisted attempts at a similar joint statement with the US as its contention was that, owing to its huge development imperatives, it was not in a position to declare a 'peaking' year like China. Any such declaration would be unrealistic and would not carry conviction. In addition, there was real apprehension of such a statement being used to criticize the government at home for bartering its right to growth. The contrast with China was coming into focus and India was being projected as a bad boy not willing to change its old attitude of standing on effete principles. Moreover, China had also offered US\$ 3 billion in finance to help poorer countries as part of 'South-South cooperation', which the US was using to impose the responsibility of mobilizing finance

on the non-Annex countries, another major departure from past positions. China had played along with the US as it had nothing to lose by this new expectation. It was, in any case, funding many developing countries and would not have been really upset if this was termed as its contribution to ‘green their economies’, as Kerry had stated in his broadside against India. China was content if its suggestion of replacing the phrase ‘countries in a position to do so’ with ‘countries willing to do so’ was accepted to describe the obligation of countries to mobilize finance as part of their effort to raise climate change finance.

India, on the other hand, opposed both the formulations. At the Paris pre-COP, I had argued that the phrase ‘in a position to do so’ implied that there would be a third party that would assess the ‘position’ of different countries and determine whether they were in a position or not, which was not acceptable. On the other hand, countries ‘willing to do so’ did not cast any obligation and would be an inert phrase in an Agreement. When the co-chair of the finance group at the pre-COP nonchalantly referred to it in his summary as a question of semantics, I raised the flag, looked at the delegate from the United Kingdom (UK) with whom I had already had a verbal duel, and said: ‘although English is not my mother tongue, according to my understanding the difference between the two is more than semantics. For example, there is a difference between the co-Chair, who is “in a position to” record the discussion accurately and whether it is “willing to do so”.’¹

Instances such as these, perhaps, could have prompted Kerry to indicate that while China appeared to accept that previous United Nations (UN) regimes—where only developed countries take action on climate—are no longer viable, he was getting ‘different vibes from Narendra Modi’s government’. ‘India has been more cautious, a little more restrained in its embrace of this new paradigm, and it’s a challenge,’ he said (Sevastopulo and Clark 2015). Kerry further stated that India’s move to expand domestic coal use was ‘not in the direction we ought to be moving in’, adding, ‘we have to be careful not to be holier-than-thou or accusatory’ (Sevastopulo and Clark 2015). The *Financial Times* suggested that these comments ‘underline how

¹ Meeting held during Paris Pre-COP, 8–10 November 2015.

tough the upcoming Paris talks could be if India—the world's fourth largest greenhouse gas emitter after China, the US and EU—plays hardball on a new agreement' (King 2015). It was part of our strategy as well to play hardball without getting into trenches that we could not vacate. The Indian environment minister called Kerry's remarks 'unwarranted' and 'unfair' (Press Trust of India 2015). He also said that India would not be 'bullied' by any country during the negotiations.

Meanwhile, the French worked dexterously on making the Paris Agreement a matter of national prestige. A diplomatic offensive was launched to garner support for the success of Paris. The Kyoto Protocol, despite all its fanfare and pious intent, had been severely weakened with the US having failed to ratify it and Canada withdrawing. The French did not want Copenhagen to be repeated, which had come to be associated with everything undesirable in international negotiations.

As part of their diplomatic outreach, the dashing French foreign minister, Laurent Fabius, toured all major countries, including India (on 20 November 2015), in an effort to persuade them to cooperate with the French presidency. In his meeting with us, the Indian side dwelt a lot on the promise of US\$ 100 billion climate finance promised by industrialized countries. The prime minister also made a point of the 'fiction' of a controversial Organisation for Economic Co-operation and Development (OECD) report on climate finance, published in the same year in October, that claimed that developed countries had 'mobilised ... for developing countries ... USD 61.8bn in 2014, up from USD 52.2bn in 2013, with an average for the two years of USD 57.0bn per year in 2013–14' (OECD 2015). The prime minister conveyed India's position in no uncertain terms and pointed to the hollowness of the claim, which lacked transparency and accuracy. The OECD report was also rebutted in a discussion paper brought out in November 2015 by the Climate Change Finance Unit of the Department of Economic Affairs, Government of India. It questioned the 'OECD report's accuracy, methodology and verifiability of the numbers reported' (Department of Economic Affairs 2015).

During the meeting, we also queried the French side on the purpose of calling the heads of states on the opening day. The

French had reversed the order by calling them in the opening plenary, whereas the custom was to call them on the final day of the high-level segment in the second week. Rumour was rife that the French had a statement up their sleeve which would be foisted as an outcome of the meeting of minds of the heads and which, in a way, would determine the restricted course of the negotiations to follow. I even asked Fabius if they were working on a joint statement, which he denied quite categorically. We were somewhat reassured by one experienced diplomat who said that it was almost impossible to get a statement out of more than 100 heads in half a day. He very emphatically stated that the French would not risk a failure at the starting point of the COP.

The build-up to Paris was also shaped by broader events, notably a terrorist attack on Paris on 13 November that killed 153 persons (Bliss 2015). There was a groundswell of support for France that had now turned into an unfortunate quarry of senseless terror. France was no longer simply a nation seeking support, but a nation that elicited the sympathy of other nations.

As the identified terrorists were migrants, climate warriors were at work trying to contrive a link between climate change and migration. They argued that climate change caused desertification, which in turn led to migration from Syria to France, which was at the heart of the attack (Bliss 2015). For instance, a November 2015 article in the *Time* magazine stated:

U.S. military officials refer to climate change as a ‘threat multiplier’ that takes issues like terrorism that would pose a threat to national security and exacerbates the damage they can cause. A 2014 Department of Defense report identifies climate change as the root of government instability that leads to widespread migration, damages infrastructure and leads to the spread of disease. ‘These gaps in governance can create an avenue for extremist ideologies and conditions that foster terrorism,’ the report says. (Worland 2015)

The developed world was adept at inventing a logic that suited their purpose. In this case, an old debate linking terrorism to climate change was being revived in order to present France as a victim of terrorism. The world could provide an effective rebuff to the recent terrorist attack by allowing France the credit of presiding over a climate

change agreement. This spin put further pressure on countries like India that were raising inconvenient arguments against developed countries.

The Road to Paris: Signalling India's Intent

Before COP 20 in Lima, India had the image of a road blocker or naysayer in the climate change discourse. In 2014, the government began to change it into a positive, proactive image, garnering trust and confidence of key countries and major negotiating groups at UNFCCC. India began to project itself not as a part of the problem, but as a country keen to be a part of the solution. India's approach during the negotiations was guided by a cabinet mandate, based on a national consensus around the long-term interests of India for development space and growth, with a view to providing basic services and energy access to all our citizens and eradication of poverty balanced with the need for combating climate change. India advocated a strong and durable climate agreement based on the extant principles and provisions of the Convention.

In the year prior to Paris, we focused on representing the interests of developing countries in COP 20 decisions at Lima and in the work of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP). For example, the note by the co-chairs dated 5 October 2015 (ADP 2015) was rejected by a number of developing countries who saw it as mitigation-centric and highly skewed in favour of developed countries. Many coalition blocks, including G77 and China, considered it a 'failed text', placing the Paris meeting in jeopardy. India took the lead and spoke to different negotiating blocks to bring back the process on track. Our work ensured that the envisaged Paris Agreement was balanced and comprehensive in its scope, by including not just mitigation but all six pillars: mitigation, adaptation, finance, capacity building, technology development and transfer, and transparency of action and support.

As part of this process, India hosted, for the first time, a meeting of senior negotiators of 25 Like-Minded Developing Countries (LMDC) on 14–15 September 2015 in New Delhi. With the collective efforts of developing countries led by India, the co-chair's draft note was considered and the parties agreed to move forward on what

we perceived as a more balanced negotiating text during the conclusion of the ADP session at Bonn on 23 October 2015. This leadership cemented further the cohesion in the LMDC negotiating block.

India's domestic policies, as articulated in our Intended Nationally Determined Contribution (INDC), were also relevant to signalling India's intent. The image of the country had received a big boost by the scaling up of the goals set for renewable energy capacity—175 gigawatt (GW) by 2022. However, after the initial euphoria, people had started questioning the scale and terming it a hollow statement of boastful intent not backed by an action plan. Questions were raised about the resources required, their availability, and whether there was a practical programme of implementation.

I was conscious of this criticism while framing the INDC and knew that this would be the high mast of our plan and had to be reflected appropriately. However, there were two challenges: first, on how to project the effort beyond 2022, the end date of the present target of 175 GW; and second, whether to delink from the resources required. An approximate calculation showed that 100 GW of solar alone may require at least US\$ 150 billion. First of all, we started using arguments of the coal saved and emissions reduced to divert discussion from the resources required. Second, we said that with so much investment, the government could have set up almost *two times* the current thermal capacity but had decided to adopt a more difficult but desirable path. After we declared the INDC on 2 October 2015, in response to a question by *The New York Times* on the availability of funds, I said that the government had never said that it would fund the entire programme itself: 'It is the role of the government to create an enabling policy framework, set up the regulatory mechanism and to prepare the system to absorb this power in its system' (Barry 2015). The government had declared its bold intention of supporting this huge effort by investing in the green corridor to facilitate evacuation and creating the regulatory framework for a market for renewable power. Having created a congenial investment climate, it was now for the market, domestic as well as international, to respond.

In our INDC document, we had taken care to present the renewable effort as creation of installed electricity capacity based on 'non-fossil' sources, thereby taking advantage of hydroelectric as well

as nuclear power. Together we were confident that we could reach a target of 40 per cent. This was the only Nationally Determined Contribution (NDC) that we linked to the availability of international finance and technology. Whatever be the holes that people found in the goal that India had set, this became the biggest talking point of the climate change debate and catapulted India into the super league—no longer a laggard, no longer a Lazarus looking for alms, but determined to demand attention by its daring declaration.

The INDC declared by India, after a prolonged period of suspense, was well received by both the Indian as well as the international communities. We had eight contributions ranging from lifestyle to mitigation, adaptation and capacity building, finance and technology transfer, and creation of additional carbon sink, besides a major shift to non-fossil fuel-based installed capacity. With the declaration of the INDC, India was perceived as a nation that was no longer in self-denial but was willing to play its part in dealing with a global problem. ‘India is not a part of the problem but would like to be a part of the solution,’ was the refrain popularized by the then environment minister, Prakash Javadekar.

Heads First: Leaders’ Day at Paris

The first day of COP 21 was a high-level leader’s segment in which more than 150 heads of state/heads of government participated. The Indian prime minister addressed the high-level leaders’ segment on 30 November 2015, outlining India’s position on key issues related to climate change negotiations. The prime minister shared his vision and views with the French and the US presidents. He also had bilateral meetings with Japanese Prime Minister Abe on the sidelines of the high-level segment. The prime minister’s visit to Paris set the stage for India playing an important role in the climate change negotiation. The attendance at the highest level from India gave a positive signal from the second-most populous nation and largest democracy in the world about our seriousness and preparedness to tackle climate change threat.

Of course, the prime minister, with his avowed commitment to renewable energy and his powerful image as a strong world leader, had carved out a place for himself as a man who mattered. He had

announced an ambitious renewable energy programme much before the Paris negotiations, and that had been hailed as a bold statement of his conviction. In fact, the world business community had started seeing this as a major economic opportunity that could transform the solar energy sector. Underscoring this point, on the first day of the meeting, Prime Minister Narendra Modi and French President Francois Hollande launched the International Solar Alliance (ISA), to bring together 121 solar-rich countries falling within the Tropic of Cancer and the Tropic of Capricorn for promotion of solar technology and its applications. The ISA aimed to facilitate joint efforts through innovative policies, projects, programmes, capacity-building measures, and financial instruments to mobilize more than US\$ 1,000 billion of investments that are needed by 2030 for the massive deployment of affordable solar energy. In addition, India joined the US in the launch of 'Mission Innovation' during the inauguration of COP. This Mission aimed to reinvigorate and accelerate global clean energy innovation with the objective to make clean energy widely affordable by providing easy access to critical clean-energy technologies. These initiatives, at the beginning of the Paris negotiations, signalled India's positive intent. India also had a fruitful meeting with the US, where both leaders had a frank discussion on national priorities and explored possible meeting grounds, recounted by President Obama's advisor, Ben Rhodes (2018), in his book, *The World as It Is: A Memoir of the Obama White House*.

Massive Outreach

India, hitherto, had been known as a country that kept its cards close to its chest. This time, however, we decided to go for a major media outreach to communicate India's stand and concerns. On the very first day of COP 21, that is, on 30 November 2015, the *Financial Times* carried an opinion article titled, 'Do Not Let Lifestyles of the Rich World Deny the Dreams of the Rest', by the Prime Minister of India, which we felt set the tone and tenor of the Conference (Modi 2015). The concerns of developing countries regarding climate-friendly lifestyles and climate justice stood powerfully articulated by the prime minister in his article.

This approach was further buttressed by appointing an affable, knowledgeable, and credible media spokesperson, who also opened an informal dialogue with people who mattered. The spokesperson held daily press briefings, besides networking with non-government organizations (NGOs) who are important opinion makers in every COP.

India set up an India Pavilion, inaugurated by the prime minister, which remained the cynosure of all delegates and visitors through the COP. Its water curtain was the most sought-after photo backdrop and the hi-tech display was found to be a convincing presentation of India's climate action. More than 25 events giving a vivid glimpse of India's diverse strategies and positive action towards mitigation and adaption to climate change, clearly demonstrating India's active efforts in combating climate change, with more than 150 speakers/panellists, were organized in the India Pavilion. The pavilion drew thousands of visitors from 65 different countries and was, arguably, the best pavilion at the COP venue.

In both formal and informal settings, we explained the Indian perspective. For example, during a private reception hosted by the British ambassador, I said that, for India, climate change was basically about development with a difference and that we would like to believe that no one present here would want those that had been, hitherto, left behind in economic progress to be in that state forever. I said that:

We quite understand that the problem of climate change is on account of the path followed in the past by the countries that have prospered. We are willing to take a different path and be guided, but don't simply tell us what not to do; instead tell us what to do and how. Understand the barriers in the path you suggest and see how they can be removed.²

I concluded that this is the spirit that has to drive the climate change dialogue rather than mutual recrimination. Similarly, halfway through the Paris COP, I gave an interview to the *Independent* in

² Meeting held during UNFCCC COP 21, 30 November–12 December 2015, Paris.

which I said, ‘India’s objective is to establish an effective agreement based on climate justice, which distinguishes between obligations of the rich countries, based on their historical responsibility in causing climate change, and the less onerous obligations of the developing world’ (Bawden 2015). Perhaps as a result of our communications efforts, public and private, by the second week we found the media less strident against India. In fact, we felt that we were no longer being considered the ‘challenge’ that we were perceived to be earlier, but a positive force to be taken along in order to achieve an effective outcome.

An effective outreach strategy was implemented through coordinated efforts, including social media initiatives, by creating a dedicated website tilted India@COP21 (<http://www.justclimateaction.org>), along with Twitter and Facebook accounts, handled jointly by the Ministries of External Affairs, Information and Broadcasting, and Environment, Forest and Climate Change. India decided to bring out a publication on its own climate-friendly traditional practices, which have been part of the psyche of its common man for years together, called *Parampara*. These efforts eventually succeeded in convincing the world that the pulse of the problem lies in excessive consumption patterns and lifestyles. Indeed, the issue of sustainable lifestyles found an appropriate expression in the preamble to the Paris Agreement. These various communication efforts disseminated the Indian viewpoint and stand on climate change-related negotiating issues, which helped in arriving at the ‘win-win’ Paris Agreement.

Focus on Key Concerns during Negotiations

India consistently took the lead in asking developed countries to commit to their obligations to cut GHG emissions. India further suggested that action in the pre-2020 period would generate momentum and confidence for all the parties—including developing countries, least developed countries, and Small Island Developing States (SIDS)—to undertake ambitious climate action post-2020. India also argued that developed countries should adhere to mobilization and joint provision of US\$ 100 billion annually in the Paris decision text, taking into account the needs and priorities of the developing countries. Mandating developing countries to

adhere to the path of carbon neutrality or net zero emissions would have serious development implications, especially when many of the developing countries, including India, are struggling to have universal access to energy and fulfil the mandate of lifting huge number of their people above the poverty line. Accordingly, India led the developing countries in ensuring that differentiation is built into the aspirational goal in Paris Agreement of reaching the global peaking of emissions by the second half of the century without mentioning any fixed timelines.

The concern on technology transfer and development was spear-headed by India in the G77 and China group, which in turn influenced its inclusion in the Paris Agreement in Article 10.

Reflections on the Final Text

The final text took into account India's core concerns on all elements of the Durban Platform relating to mitigation (emissions reduction), adaptation, finance, technology, capacity building, and transparency of action and support. Some of the salient features of the Agreement are as follows:

1. The Paris Agreement is firmly anchored in the UNFCCC—its purpose is to enhance the implementation of the UNFCCC, including its objective. This is a major accomplishment for developing countries since it safeguards policy space underpinned by key principles such as equity and common but differentiated responsibilities and respective capabilities (CBDR&RC). Developed countries, on the other hand, had wanted the purpose of the Paris Agreement to be restricted to achieving the objective of the Convention rather than enhancing its implementation. This failed effort to delink the two was significant.
2. The preamble to the Agreement explicitly recognizes the imperatives of climate justice, sustainable lifestyles, and the right to development, ideas that were specifically brought on the table by India. The notion of climate justice has been acknowledged in a UN document on climate change for the first time.
3. The Agreement will be implemented to reflect 'equity and CBDR&RC' in light of different national circumstances. In

our view, this captures the notion of historical responsibility of developed countries as being largely responsible for contributing to climate change, and therefore highlights the necessity for these countries to take the lead in GHG emissions reduction and to enable the developing countries to take ambitious climate action through provision of finance, technology development, and technology transfer.

4. One of the key issues articulated by developing countries, including India, was to see operationalization of the principle of CBDR&RC in the form of differentiated obligations for developed and developing countries. While differentiation based on the annexes enshrined in the 1992 Convention could not be reflected in the Paris Agreement explicitly because of an extremely hard, adversarial position taken against this by developed countries, we were able to reflect some element of differentiation across all elements of the Agreement. This is something which is extremely useful from the perspective of implementation of commitments under the Convention.
5. The differentiation in mitigation is on both the 'scale' and the 'nature' of efforts. The Agreement differentiates in the form of efforts parties will undertake: while developed countries will undertake absolute reduction targets, developing countries are to enhance mitigation efforts (such as those undertaken currently, including relative targets), with an encouragement to progressively move towards 'reduction or limitation targets' taking into account their national circumstances.
6. The NDCs are not restricted to mitigation alone, and could include other elements. The developed countries wanted the NDCs to be restricted to mitigation alone. This was a major item of contention between the developed and some developing countries (led primarily by the LMDC group), and we were able to secure the broader framework.
7. The NDCs are to be furnished every 5 years and, importantly, remain nationally determined. While any party is free to raise their ambition at any time, the Agreement contains no provision on ex ante or ex post review to compel revision of the NDCs through a mandatory process, which was a priority concern for India and other developing countries.

8. The Agreement clearly recognizes the need to provide support to developing country parties for effective implementation of their mitigation and adaptation actions, and it contains an obligation for developed countries to provide financial resources to developing countries. The mandatory provision of finance is for both mitigation and adaptation, and the Agreement also notes the linkage between enhanced support and higher ambition by developing countries. The encouragement to other parties (other than developed countries) to offer such support is on a voluntary basis, despite an intense effort by developed countries to dilute their responsibility and draw some developing countries into this equation. There is a reporting requirement on developed countries with respect to their financial commitments and the global stocktake is also supposed to take into account progress on climate finance.
9. The developed countries have agreed to continue with the mobilization of US\$ 100 billion per year post 2020 and to set a collective short-term goal for climate finance every five years. Much will depend on how they mobilize such finance and how climate finance is calculated as there is no internationally accepted definition of climate finance at present.
10. The transparency arrangements for the new Agreement were a major issue of contention between the developed and developing countries. Developed countries, led by the US and EU, wanted to have a common transparency framework applicable to all countries, with some flexibility for developing countries with limited capacities. The developing countries wanted the existing differentiated arrangements to continue as, among other reasons, these have not yet been fully implemented. What has been agreed under the Paris Agreement is an enhanced transparency framework which will build on the arrangements under the Convention, which implies retention of the principle of differentiation. The work on modalities and guidelines for the enhanced transparency framework is ongoing. A capacity-building initiative linked with transparency was an Indian proposal and has been agreed upon.
11. One of the provisions of the Agreement, that is, Article 2.1(c), refers to 'Making financial flows consistent with a pathway

towards low GHG emissions and climate resilient development.’ This was included despite vehement opposition from India and a large number of developing countries and could be interpreted as ‘green conditionalities’ on the movement of international finance. This is an aspect which will need to be addressed in this context and elsewhere in the future too, so as to ensure that it does not limit our policy space.

Outcome

Overall, our negotiators managed to preserve India’s core interests in the Paris Agreement. Many of our articulations and positions were put forth as group positions, mainly through the configuration of the LMDC group. The BASIC group (Brazil, India, China, and South Africa) also met several times at the ministerial level to articulate a common strategy on a few key issues. Issues on which the developing countries were united (adaptation, finance, capacity building) were negotiated through the G77 and China.

The Paris Agreement ensures that our developmental space will not be constricted by a top-down approach, and also that our contributions to counter climate change will remain nationally determined in years to come. From our perspective, this is the most important issue and one on which we were able to preserve our position. Going forward, so long as our climate action is nationally determined based on our national priorities and resources and there is no international process that can oblige us to revise our contributions upwards, we will be able to preserve our developmental space; the Paris Agreement does not place onerous obligations on that freedom of action.

In sum, the Paris Agreement, while not being perfect from the point of view of either the developing or the developed countries, can be said to meet the expectations of both sides and embodies a delicate balance of positions of either side. While India and other developing countries were able to preserve the fundamental tenets of the UNFCCC and thereby our developmental policy space, the developed world secured substantial gains in terms of a strong mitigation and transparency framework. Much will now depend on how the various details, modalities, and guidelines are framed for

giving effect to the provisions of the Agreement in the period before entry-into-force of the Paris Agreement and how we will continue to remain fully engaged in that process.

In the final analysis, I think what worked for India was a firm handling of the key players while keeping some channels open, that is, an accommodating approach on some issues in order to seek flexibility from others on issues that mattered to us, such as: keeping the Montreal Protocol amendments open till the conclusion of Paris Agreement, good rapport with the COP president, *support* of our traditional allies, tactical moves at the appropriate time, stern messaging and posturing on the penultimate day, liberal interaction with media and NGOs, building a convincing case for development by our logically argued outreach efforts, and a proactive and positive stance by India throughout that capitalized on the positive and dynamic image of the prime minister.

References

- Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP). 2015. 'Note by the Co-Chairs', Draft Agreement, Paris. Available at <https://unfccc.int/resource/docs/2015/adp2/eng/8infnot.pdf>; accessed on 29 May 2019.
- Barry, Ellen. 2015. 'For Indians, Smog and Poverty Are Higher Priorities Than Talks in Paris', *The New York Times*, 21 December. Available at <https://www.nytimes.com/2015/12/10/world/asia/india-climate-change-global-warming.html>; accessed on 29 May 2019.
- Bawden, Tom. 2015. 'COP21: UN Conference Hears Calls for Decisive and Far-Reaching Agreement', *Independent*, 7 December. Available at <https://www.independent.co.uk/news/world/europe/cop21-un-conference-hears-calls-for-decisive-and-far-reaching-agreement-a6764141.html>; accessed on 29 May 2019.
- Bliss, Laura. 2015. 'How Friday's Attacks Raise the Stakes for the Paris Climate Talks', *CityLab*, 16 November. Available at <http://www.citylab.com/weather/2015/11/how-fridays-attacks-raise-the-stakes-for-the-paris-climate-talks/416178/>; accessed on 29 May 2019.
- Department of Economic Affairs. 2015. 'Climate Change Finance, Analysis of a Recent OECD Report: Some Credible Facts Needed', Discussion Paper. New Delhi: Ministry of Finance, Government of India. Available at https://dea.gov.in/sites/default/files/ClimateChangeOEFDReport_0.pdf; accessed on 29 May 2019.

- King, Ed. 2015. 'John Kerry: India Poses "Challenge" at UN Climate Talks', *Financial Times*, 12 November. Available at <http://www.climatechangenews.com/2015/11/12/john-kerry-india-poses-challenge-at-un-climate-talks/>; accessed on 29 May 2019.
- Modi, Narendra. 2015. 'The Rich World Must Take Greater Responsibility for Climate Change', *Financial Times*, 30 November 2015. Available at <https://www.ft.com/content/03a251c6-95f7-11e5-9228-87e603d47bdc>.
- Office of the Press Secretary. 2014. 'U.S.–China Joint Announcement on Climate Change', *The White House*. Available at <https://obamawhitehouse.archives.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change>; accessed on 29 May 2019.
- Organisation for Economic Co-operation and Development (OECD). 2015. *Climate Finance in 2013–14 and the USD 100 Billion Goal: A Report by the OECD in Collaboration with Climate Policy Initiative*. Paris: OECD. Available at <http://www.oecd.org/env/climate-finance-in-2013-14-and-the-usd-100-billion-goal-9789264249424-en.htm>; accessed on 29 May 2019.
- Press Trust of India. 2015. 'India Hits Out at Kerry for Terming It a "Challenge" at Paris Climate Meet', *The Indian Express*, 22 November. Available at, <https://indianexpress.com/article/india/india-news-india/india-hits-out-at-kerry-for-terming-it-a-challenge-at-paris-meet/>; accessed on 29 May 2019.
- Rhodes, Ben. 2018. *The World As It Is: A Memoir of the Obama White House*. New York: Penguin Random House.
- Sevastopulo, Demetri and Pilita Clark. 2015. 'Paris Climate Deal Will Not Be a Legally Binding Treaty', *Financial Times*, 12 November. Available at <https://www.ft.com/content/79daf872-8894-11e5-90de-f44762bf9896>; accessed on 29 May 2019.
- Worland, Justin. 2015. 'Why Climate Change and Terrorism Are Connected', *Time*, 15 November. Available at <http://time.com/4113801/climate-change-terrorism/>; accessed on 29 May 2019.

India in International Climate Negotiations

Chequered Trajectory

D. Raghunandan

India's stance at and approach towards the international negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) have evolved through several phases. Officially, India proclaims that it has staunchly guarded its national interests, warding off incessant efforts by developed countries to impose emissions control obligations and other onerous burdens on India, and acted unswervingly in favour of developing countries (Ghosh 2012). This claim has been broadly accepted, even if grudgingly, by sections of academics, the media, and even by activists or non-governmental organizations (NGOs) in India, especially in the face of intransigent behaviour by the United States (US) and other developed countries. However, such a portrayal betrays a confirmation bias towards a hypothesis often proffered by key official interlocutors themselves, and also misses some discernible shifts in the negotiating framework and possible explanations for them. A more critical appraisal of India's

stance and floor tactics would reveal a rather less praiseworthy and more inconsistent position, often not matching official rhetoric and self-perception.

Starting from a proactive and creative early phase, notably during the formulation of the UNFCCC, India's perspective and tactics shifted to a relatively quiescent posture. As the Kyoto Protocol (KP) gradually took shape and came into force, India further moved to somewhat peculiar interventions looking to game the negotiations process, but in effect contributing, along with other countries, to considerable damage to the integrity and effectiveness of the Protocol. As negotiations moved to defining and shaping the architecture of the second phase of the KP, India floundered between striving to stave off US and other developed country pressures to take on emissions reduction commitments and seeking to advance a strategic alliance with the US. In the lead up to, and at, the Copenhagen and Cancun summits, where the foundations of a new, post-Kyoto emissions control architecture were laid, India made a paradigm shift by committing to a voluntary emissions reduction pledge, but failed to leverage this momentous change to elicit emission cuts by developed countries. India, thus, ended up at Paris meekly accepting a US-engineered architecture with deleterious consequences for the earlier hard-won equity between developed and developing nations, for adherence to the requirements of science for controlling climate change, and for its own national interests with regard to domestic climate vulnerabilities and impacts.

In particular, India did not build its own capacities in understanding climate science or formulate its negotiating positions based on that understanding. India approached the climate negotiations as primarily a problem of foreign relations, rather than as a forum to deal with and help tackle its serious vulnerabilities to climate impacts. In later periods, India mistakenly forged an alliance with developed countries, especially the US, at the cost of traditional allies in developing countries, especially Small Island Developing States (SIDS) and least developed countries (LDCs), and was slow to realize the import of its own economic development at the turn of the millennium, especially how this was perceived by other developing countries, and make suitable adjustments to its negotiating position. Through all these phases, India adopted a defensive and reactive posture—fending off

pressures from developed countries—rather than a proactive one projecting its own core concerns regarding climate change and pressing for enhanced actions by developed countries. Consequently, serious questions arise as to whether, or to what extent, India's negotiating position truly promoted outcomes enabling the country to better deal with the serious challenges it faces due to climate change, and advance its own vital developmental interests along with those of other developing countries.

India has paid insufficient attention over the years to its own vulnerabilities to climate change. The serious impacts these may have on India, and South Asia in general, have been made clear in successive assessment reports of the Intergovernmental Panel on Climate Change (IPCC), especially in the *Fourth* and *Fifth Assessment Reports*. India's own *Second National Communication* (otherwise known as NATCOM 2) to the UNFCCC in 2012 and a series of studies commissioned by India's Ministry of Environment and Forests (MoEF) under the Indian Network for Climate Change Assessment (INCCA 2010) contain the hitherto most authoritative estimates of climate impacts in India over the near to medium term, and some projections for the longer term till the end of the century.¹

As a brief snapshot, India has close to 18 per cent of the world's population and, despite the much-hyped rapid economic growth in recent years, carries a huge burden of poverty and underdevelopment, with human development index rankings similar to LDCs in most indicators. Agricultural production in India is expected to be badly affected in both quantity and quality by changes in climatic patterns, variations in rainfall, and shift in onset and withdrawal of monsoons (MoEF 2012).² About 65 per cent of its people live in rural areas, are mostly poor and dependent on agriculture, with over 60 per cent of the cropped area being rain-fed and highly climate sensitive. India's long coastline has many heavily populated towns and cities along it,

¹ Some people may argue that other studies show different and more accurate estimates. However, as with the IPCC assessment reports, I have preferred to go with the NATCOM and related studies (in INCCA 2010) as the most reliable evidence at hand, unless established otherwise in a fairly conclusive manner through widely accepted peer-reviewed studies.

² The climate impact data in this section are taken from MoEF (2012).

all facing threats from sea-level rise and coastal erosion. The already most marginalized sections of its people are also the most vulnerable to climate impacts.

Whereas India may not be among the ‘canaries of climate change’ facing an existential threat like small island states, it is, along with other South Asian nations, among the most severely affected regions of the world (Hijioka et al. 2014). Like the island states and LDCs, India too therefore has a vital interest in working assiduously towards minimizing temperature rise and related climate impacts. Unfortunately, India’s climate vulnerabilities were never major drivers of its climate policy, nor were they allowed to significantly shape India’s negotiating position. If India’s stance had indeed been based on the science, that is, on limiting global temperature rise and on emission cuts required to achieve those goals, and had been domestically rather than externally driven, it may well have evolved very differently, possibly even leading to a different outcome of the negotiations.

Early Phase: Major Contributions from 1990 to 1992

During the early 1990s, when the Convention was being shaped, India indeed championed the cause of developing nations, who were waging highly asymmetrical battles against developed countries that were armed with scientific data and were seeking to build a case for shifting responsibility for greenhouse gas (GHG) emissions on to developing countries. As explained later, strenuous attempts were made, particularly by the US, to drag various red herrings through the deliberations, taking advantage of a perceived lower level of scientific knowledge among developing countries.

One of these was the erroneous, yet for a while vigorously pursued, argument that methane emissions from rice paddies and from cattle and pig rearing—widespread in India, China, and other populous regions of Asia—were the major causes of climate change and should therefore be the focus of mitigation efforts. India and many observers saw this as an attempt to divert attention away from the predominant warming role of fossil fuel-based carbon dioxide (CO₂), historically emanating mostly from industrialized nations. A team of scientists from India conducted intensive

studies of emissions from paddy fields and, combined with other science, successfully refuted this contention (Parashar et al. 1996; Ramachandran 2012),³ thereby also establishing that India and other developing countries were alert to such tactics and had the capacity to deal with them scientifically.

Developed countries further argued that developing nations had large and growing populations and therefore, it stood to reason that they would discharge higher quantities of GHGs. The official Indian delegation, assisted by significant NGO contributions, specifically by Sunita Narain and the late Anil Agarwal of the Centre for Science and Environment, saw this as a politically motivated campaign and worked to correctly anchor the discussions to per capita rather than total national emissions, and to the historical responsibility of developed countries whose enormous past emissions since the industrial era had triggered climate change (Agarwal and Narain 2012). These Indian interventions, along with substantive contributions to the language of the text, particularly equitable burden sharing in reduction of emissions, played a crucial role in the formulation of key elements of the Convention. These also formed the basis for major UNFCCC principles, such as demarcating between developed and developing countries based on common but differentiated responsibilities and respective capabilities (CBDR&RC), and for the emissions control architecture under the consequent KP (Chapter 8).

However, once these battles were effectively won, India did not sustain this intensity of involvement in making substantive contributions to climate science and to operational formulations relating to the emissions control architecture. Little work was done in research and academic institutions in India to understand the impacts of climate change in the subcontinent and how resilience to them could be built, or to examine possible strategies to mitigate emissions globally and domestically. These deficiencies were in part due to weaknesses in institutional capacities, particularly in climate science and related policies, and in part due to the official perspective of

³ Later studies showed that this early research had underestimated methane emissions, but this does not take away from the fact that methane emissions are still a small fraction of CO₂ emissions and an even smaller fraction of total GHG emissions.

the international climate negotiations, which were viewed mainly as an extension of India's diplomacy and subservient to larger foreign policy objectives. Whatever the reasons, the result was that India ceded substantial ground to developed countries in setting the future agenda, with serious consequences for outcomes.

Treading Water: 1992–7

In the period after formulation of the Convention and the delineation of the KP, roughly 1992–7, which had seemingly laid out the basics of the international emissions control architecture and the respective responsibilities of developed and developing countries visualized as clearly demarcated binaries, India transitioned from its earlier activist phase into a phase of relative quiescence. In the opinion of this writer and several others, the official Indian position during this period gradually ossified into stonewalling of persistent developed country efforts to breach the developed–developing firewall, and belabouring concerns about funding and transfer of technology from the developed countries (Vihma 2011). Undoubtedly, these issues were and remain important. However, fixating on these issues meant that India did not adequately prepare for, and was unable to mount, effective evidence-based campaigns to address the critical issue of inexorable global warming and to press developed nations to raise their emissions reduction commitments. This inability by India and other developing countries to take a lead in framing key issues at the negotiations left the field open to the US and its allies to set the agenda and, over time, build alliances with groups of developing countries to the detriment of Indian interests.

Thrashing About: 1997–2005

This quiescent period was followed by a phase in which, to continue with the swimming analogy, India was not steady in the water but rather flailing about without strategic purpose or direction, other than to ward off pressures to reduce its emissions. In the period between the KP being agreed and its ratification by the requisite number of countries for coming into force (roughly 1997–2005), India flirted with, if not embraced, several positions that detracted

from the main global goal of limiting global warming by ensuring commensurate emissions reductions by developed countries, which would of course also help ameliorate climate impacts in India. These positions cumulatively conveyed an impression that India was evasive on important issues relating to this goal. Despite its championing the cause of developing countries, India showed during this period that it was not averse to tactical alliances with the US and other developed countries if these seemed to serve some short-term geostrategic purpose, even at the cost of ignoring the science and accepting reduced emission cuts by them.

During this time, many countries colluded, both directly and indirectly, with endeavours by the US and some allies to defang the KP by lobbying for case-specific treatment, newly introduced mechanisms for accounting of emissions reduction, and other special provisions, as the price for ratifying the Protocol, causing an immense setback to the battle against climate change (Sprinz 2001). Regrettably, India too joined this trend of countries gaming the negotiations process in an attempt to gain benefits for themselves at the cost of the integrity and effectiveness of the KP itself.

For instance, offsets were built in to the KP which permitted developed countries to take on mitigation measures like afforestation in developing countries that could be discounted against the formers' own emissions reduction obligations, giving them a less expensive way of supposedly reducing global emissions, albeit with uncertain outcomes. Similarly, a Clean Development Mechanism (CDM) was introduced, ostensibly to facilitate introduction of energy-efficient or other emissions-saving technologies by developed countries in developing nations, allowing the former to trade 'carbon credits' and offset these against their own actual emissions. Special concessions were given to countries such as Australia, Canada, and others because of their high dependence on coal. Also, Russia, which threatened to not ratify the KP and thus prevent it from reaching the required 55 per cent of global emissions, extracted huge allowances for emissions 'avoided' due to the severe economic downturn in post-Soviet times, derisively termed 'hot air' by critics. To all these, India was either a silent spectator along with many other major players or even went along with specious proposals such as offsets and CDMs, perhaps in the hope of some financial gains (Raghunandan 2002). Some

companies in India did make considerable amounts from CDMs, but the quantum of emissions actually saved has remained questionable (Dutt 2009).

In another controversial move in the context of the times, India joined a perhaps well-intentioned but counterproductive chorus in the negotiations to shift focus to adaptation rather than mitigation—the idea being to draw attention and funding towards addressing climate impacts in developing countries. Unfortunately, this contributed to a drop in attention to the core issue of continuing high emissions by developed countries and the urgent need to take preventive action.

The US, of course, did the most to weaken the KP, maintaining that it would not join any global compact that exempted developing countries, particularly major economies such as India, China, and Brazil, and finally dropped out of Kyoto altogether soon after George W. Bush took over as president in 2001 (Reynolds 2001). When all 164 remaining countries decided to stay in the KP despite the US departure, it was hailed as a great victory against big odds, but the US continued shaping the global emissions control negotiations towards outcomes it preferred.

Various other countries, both developed and developing, played a role in this charade. At the 8th Conference of the Parties (COP 8) in Delhi, for instance, following which India held the COP presidency till the next year, India played a particularly lamentable role. While the European Union (EU) deplored the US position of withdrawing from the KP on the one hand, it advanced the US agenda on the other by raking up the developed–developing divide, which had been resolved earlier in the face of the US onslaught and in united defiance of its withdrawal. The EU pushed for developing countries to begin defining obligations they would take on, even though the agreed time to do so was many years later when discussions on a post-Kyoto arrangement were scheduled to begin. In a clearly orchestrated move, Saudi Arabia, long a climate denier, incredibly led an Organization of Petroleum Exporting Countries (OPEC) charge defending developing countries and sharply polarizing the conference. The Indian prime minister's inaugural address had also harped on this theme, defying delegates' expectations that the conference would discuss

substantive issues relating to implementation of the KP and filling in the blanks from the previous COP.

The Indian draft declaration summing up the conference was also too clever by half, full of platitudes and high-sounding sentiments, but avoiding the main issues exercising the delegates. The draft, shockingly, did not even mention the KP, ostensibly on the grounds that it had not yet entered into force, even though its substance was precisely the subject of discussions at the conference. It also did not mention the word 'mitigation', emphasizing India's liking for a focus on adaptation rather than emissions reduction, much to the delight of the US and its allies. Many observers noted that the draft also stressed aspects extrapolated from the recent World Summit on Sustainable Development, revealing India's preference for looking at climate change as an extension of sustainable development. Ultimately, the draft showed India's customary penchant for wordsmithy as opposed to substance, supposedly conveying a consensus that did not exist. In a huge blow to India's prestige, this draft was summarily rejected by the conference (Raghunandan 2002). An informal gathering of observers and NGOs awarded a 'worst performance' award to the US, Saudi Arabia, and India for derailing the conference. Great company indeed!

India's US Dalliance and Paradigm Shift: 2005–15

In the late 1990s and into the new millennium, India and some other large developing countries witnessed high gross domestic product (GDP) growth, adding to the major geopolitical changes prompted earlier by the collapse of the Soviet Union and the East European bloc. The spectacular economic growth of China and its rising international influence also helped shape new alliances and groupings. The US and other developed country powers sought to draw the so-called 'emerging economies' into their orbit on major geopolitical and economic issues of the day, including climate change.

India, which was also recasting its foreign policy in the post-Soviet era, was now avidly pursuing a strategic alliance with the US. This new Indo-US relationship was beginning to find concrete expressions in efforts towards a far-reaching defence agreement and a path-breaking nuclear deal, seen in India as a watershed moment for its

international relations and enhanced standing. India, therefore, saw advantage in going along with the US at various international forums, especially, of immediate relevance here, in relation to climate change (for a more detailed discussion on this aspect, see Raghunandan 2012). India's own GHG emissions were by now quite substantial in absolute terms, although not in per capita terms, and were drawing international attention as the world's third or fourth largest among nations. Taken together with its new-found economic rise and aspirations of global leadership, these growing numbers made it increasingly difficult for India to persist with its earlier position of claiming to be at par with other developing countries and hence under no obligation to take on emissions reduction commitments, despite the fact that India continued to carry an enormous poverty burden and development deficit. Meanwhile, other large developing countries such as China, Brazil, Mexico, South Africa, and Indonesia were also now indicating that they were not averse to reducing their emissions by differing degrees.

Significant changes were also taking place in Indian domestic public opinion after the release of the IPCC *Fourth Assessment Report* (AR4) in 2007. Influential sections of civil society and academia advocated, for the first time, that India should now offer to reduce its emissions growth rate, not because it was a part of the problem of climate change primarily caused by the historical emissions of developed countries, but because it wanted to be part of the solution. The IPCC AR4 had indeed stated that even if developed countries made the deep emission cuts called for in the report, large developing countries too would have to ensure that their future emissions '*deviate below their projected baseline emissions*' (Metz et al. 2007; emphasis added). For example, a group of academics and civil society actors (including this author) suggested that India offer to reduce its emission flows below the then current trajectories as its contribution to the global effort, despite being a developing country with huge climate vulnerabilities and developmental needs (Progressive Climate Policy Campaign-India 2009). Importantly, the suggestion was that this offer be made *conditional upon* developed countries committing to the deep emission cuts called for, which would have thrown the ball in the developed countries' court and put pressure on them. India, it was felt, had the economic strength and technological

capability to take on such a posture so as to contribute to the global effort, while still retaining the ability to deal with domestic developmental priorities. It was further argued that such a position by India would enable it to reconcile the apparently contradictory pulls exerted on its negotiating position by its economic growth and technological capability on the one hand, and its low per capita energy consumption and development deficit on the other, while potentially changing the dynamic in the climate negotiations.

All these factors combined to see India making a paradigmatic shift in its international negotiating position on the eve of the Copenhagen Summit, and committing itself to reducing its emissions intensity by 20–5 per cent by 2025, overcoming its earlier rigid stance on the hard differentiation enshrined in the KP between developed and developing countries. As discussed later, however, India was unable to leverage this dramatic shift to secure deeper emission cuts by developed countries, or even to enhance its own international prestige.

In a series of G8 summits, starting with Heiligendamm in Germany in 2007, major ‘emerging economies’ were invited to sit in at the high table of global powers. These summits discussed various economic and other challenges facing the international community, including climate change. At these summits of the ‘G8+5’, which soon morphed into the Major Economies Forum (MEF) and then into the G20, India, clearly enjoying its new-found ‘big boy’ status and perhaps also driven by hubris, allowed itself to be herded into a set of US-led formulations on climate change. These formulations fundamentally changed the prevalent international emissions control architecture and the UNFCCC understanding of equity between nations as manifested in the principle of common but differentiated responsibilities (CBDR) (Raghunandan 2012).⁴ They also provided the essential building blocks for the language of declarations adopted at the climate conferences at Copenhagen (2009), Cancun (2010), and Durban (2011), which formed the core of the new climate architecture ultimately adopted at Paris in 2015. These building

⁴ See even more detailed accounts following the G8 summits at Heiligendamm, L'Aquila, and Toyako in blogs by the author. Available at www.delhiscienceforum.net. See also Chapter 7 in this volume.

blocks included the global goal of limiting temperature rise to 2°C (with ambition to address 1.5°C added at Cancun), an agreement on mitigation efforts to be made by all countries with, however, some differentiation for developing countries, scant mention of the deep cuts to be made by developed countries, and playing down of historical emissions.

The 'single framework' clubbing together developed and developing countries under a common umbrella, long desired by the US, was introduced at Copenhagen and formalized in Cancun, pushed mostly by the same countries, with the addition of a 'pledge and review' system of voluntary emission reduction commitments. This latter system, while maintaining some differentiation between developed and developing countries by allowing for differing degrees or phasing of emissions reductions pledged, in practical terms gave much greater leeway to the former. The omission of historical emissions from any calculus for arriving at fair and equitable national actions by developed countries was particularly egregious, especially since the role of historical emissions by developed countries in contributing to climate change had been well recognized in the UNFCCC and IPCC reports. Further details of the significance of the emissions control architecture agreed at Paris are discussed in Chapter 12 in this volume.

That this was a well-thought-out stratagem pursued over many years by the US was made clear after the Copenhagen Summit by no less than then Secretary of State Hillary Clinton in a signed opinion editorial (op-ed) article (Clinton 2009). She averred that the Obama administration's position at Copenhagen was no aberration, represented continuity from the Bush era, and that the US indeed saw itself, China, and India as part of the same club and therefore wanted a single framework for all of them. Clinton wrote that success at Copenhagen required that 'all major economies, developed and developing, need to take robust action to reduce their carbon emissions', that 'they agree to a system that enables full transparency' (that is, commitments by India and China too should be subject to verification as with developed country targets), and that the US had taken the lead to bring developed and key developing countries together to tackle climate change through initiatives such as the 'Major Economies Forum ...

and agreements at the G-20 and the Asia-Pacific Economic Cooperation' meetings.

The almost unidimensional approach by India to international climate negotiations, focusing on alignment with US positions as part of a reoriented foreign policy seeking a strategic alliance with the now sole superpower, also led India to neglect its traditional associations with developing countries and fail to incorporate their concerns into its negotiating position. Additionally, India had not fully appreciated the substantial shift evolving in the positions of many developing nations, especially LDCs, SIDS, and countries in Africa, whose voice it had earlier effectively championed during the KP negotiations. These countries now viewed climate change as posing an existential threat and were pushing for urgent action to counter it. Further, they now increasingly saw large developing countries, including India, as part of the problem, and these perceptions were shrewdly capitalized on by the US, the EU, and others to push for larger emission reduction commitments and other concessions by large developing countries, including by cynically accepting a more ambitious 1.5°C goal even while pulling back from commitments conforming even to a 2°C pathway and from financial and technical assistance to developing nations.

India too faced serious climate impacts and could have made common cause with the LDCs and the island states, but could not find a way to reconcile this with its own high economic growth and concomitant growing emissions, along with its desire to be part of the 'big boys' club'. India was, therefore, badly affected by the aforementioned shift in position by a large group of developing countries. In the run-up to Copenhagen, China, Brazil, and many others had, as noted earlier, already declared their willingness to take on mitigation obligations, leaving India as a virtually lone hold-out among nations with large emission flows. India's isolation was brought home sharply at the Durban COP in 2013 when India found itself under attack from both developed and developing countries when it refused to accept language calling for legally binding commitments, exposing itself to immense pressure and opprobrium (Raghunandan 2011), as well as to the however incorrect perception, poignantly voiced by Grenada's lead delegate and spokesperson for the island states, that India was conveying that 'while they develop, we die' (Black 2011).

India's foreign relations-driven climate policy had also led to a blindness to the science. While India and other developing countries had substantially shifted ground in the run-up to and in the Paris Agreement itself, they had also collectively allowed the 2°C goal to be given short shrift and let the US and other developed countries off the hook. The latter did not take on the deep emission cuts demanded by science and by the IPCC assessment reports and other studies. They were allowed to ignore their historical emissions in working out future responsibilities, and were thus permitted to continue occupation of atmospheric space. This left little atmospheric space for the developing countries to use for their medium-term future development (Kanitkar et al. 2013), having already ceded much of what space they could have had by taking on emission reduction commitments in Paris.

India continues to labour under multiple, seemingly conflicting demands on its negotiating position. India has low per capita emissions, poverty burden, and development deficit, yet its current economic growth results in relatively high annual emissions. Its traditional alliance with developing countries along with a shared, pressing concern about climate impacts demands more urgent, effective action to reduce global emissions, especially by developed countries, yet it wants to play a leadership role on global issues, including climate change, in the company of leading developed nations. It retains focus on its original, defining stance on equity between nations based on historical per capita emissions and resisting pressures to take on unfair emission reduction demands, yet it seeks to be flexible about an increasingly unsustainable firewall between developed and developing countries. The tension between these imperatives is reflected in India's stance in the negotiations and, certainly to the discerning eye, also in India's Intended Nationally Determined Contribution within the framework of the Paris Agreement (Dubash and Khosla 2015; Raghunandan 2015).

In the final analysis, the global agreement finalized at Paris met neither the requirements of science nor the needs of international equity, that is, for developed and developing countries to shoulder a

'fair share' of the emissions reduction burden. On its part, India did not adopt a science-based approach, which would have led to a better appreciation of the threats it faces from climate change, minimizing which would then have been the main goal. A domestically driven perspective focusing on climate impacts on the subcontinent, rather than one driven by foreign relations considerations, would also have lent urgency to the need for an effective global compact to limit global warming. A better floor strategy in the negotiations—placing less reliance on cozying up to the US and other developed countries and consistently standing with other developing countries, as warranted by India's poverty burden and development deficits—would also have served India better. Crucially, India also failed to factor in its own economic growth story and could not find a way to reconcile this with its traditional position favouring the Kyoto firewall between developed and developing countries. Had India's negotiating position not been this mixed bag of early creative interaction followed by vacillations, missed opportunities, misplaced alliances, and a failure to capitalize even on a belated paradigm change, its role in shaping the global emissions control architecture would have been quite different and might even have engendered a different outcome. As things stand, the Paris Agreement is a low-ambition emissions control regime, with an architecture favouring developed countries and distributing the burden unfairly among 'all countries' by ignoring historic responsibility, while allowing developed nations to substantially defer enhanced commitments under the KP till the new commitments kick in.

However, the story does not end with the Paris Agreement. There is still much work to be done, now and in the coming years, on many important issues. The issue of dealing with the higher-ambition 1.5°C goal is yet to be dealt with in an effective manner, yet with sensitivity towards the perceptions of the island states and LDCs. The anticipated upward revision of Nationally Determined Contributions (NDCs) is to take place in 2020, and unless some meaningful science-based metric is worked out to incorporate historical emissions of developed countries and as to how different countries should make upward revisions in such a way as to ensure adequacy to meet the 2°C goal, the world may again well be left with another ineffective set of voluntary pledges. The global stocktakes in 2025 and

beyond also loom, and these again will not meet requirement unless the vexed issue of adequacy is tackled. India will undoubtedly face many challenges in the years ahead, not least the pressure of taking on ever-greater mitigation burdens, and many of the old dilemmas will continue to vex India. However, lessons from the negotiations thus far, if learned well, could prove useful, and India would do well to approach the negotiations differently than in the past, focusing on broader outcomes rather than on daily skirmishes. India's national interests, given the severe climate impacts it is likely to face in the years to come, demand no less.

India will also face enormous challenges on the domestic front. India's NDC commitments are at present relatively modest, which, it must be said, is acceptable in the face of shamefully low emission reduction commitments by developed countries. In the longer term, these commitments will need to be approached with far greater cohesion and more cross-sectoral perspectives than hitherto, especially addressing issues of domestic inequities, rather than being based only on a concern for satisfying international audiences. Both the international negotiations and the low-carbon pathways within India will require a chiefly domestic starting point.

References

- Agarwal, Anil and Sunita Narain. 2012. 'Global Warming in an Unequal World: A Case of Environmental Colonialism (Selected Excerpts)', in *Handbook of Climate Change and India*. New Delhi: Oxford University Press, pp. 81–9. Available at <https://doi.org/10.4324/9780203153284-16>.
- Black, Richard. 2011. 'Climate Talks End with Late Deal', *BBC News*, 11 December. Available at <https://www.bbc.com/news/science-environment-16124670>; accessed on 10 June 2019.
- Clinton, Hillary Rodham. 2009. 'The U.S. Is on Board', *The New York Times*, 14 December. Available at <https://www.nytimes.com/2009/12/15/opinion/15iht-edclinton.html>; accessed on 10 June 2019.
- Dubash, Navroz K. and Radhika Khosla. 2015. 'Neither Brake nor Accelerator', *Economic & Political Weekly*, 50(42). Available at <https://www.epw.in/journal/2015/42/commentary/neither-brake-nor-accelerator.html>; accessed on 10 June 2019.
- Dutt, Gautam. 2009. 'A Climate Agreement beyond 2012', *Economic & Political Weekly*, 44(45): 39–49.

- Ghosh, Prodipto. 2012. 'Climate Change Debate: The Rationale of India's Position', in *Handbook of Climate Change and India: Development, Politics and Governance*, pp. 157–67. Oxford University Press.
- Hijioka, Y., E. Lin, J.J. Pereira, R.T. Corlett, X. Cui, G.E. Insarov, R.D. Lasco, E. Lindgren, and A. Surjan. 2014. 'Asia', in V.R. Barros, C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir et al. (eds), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 1327–70. Cambridge, UK, and New York, NY: Cambridge University Press.
- Indian Network for Climate Change Assessment (INCCA). 2010. 'Climate Change and India: A 4x4 Assessment—A Sectoral and Regional Analysis for 2030s', Report No. 2. Available at <http://moef.gov.in/indian-network-for-climate-change-assessment/>; accessed on 10 June 2019.
- Kanitkar, Tejal, T. Jayaraman, Mario D'Souza, and Prabir Purkayastha. 2013. 'Carbon Budgets for Climate Change Mitigation—A GAMS-Based Emissions Model', *Current Science*, 104(9): 1200–6.
- Metz, Bert, Ogunlade Davidson, Peter Bosch, and Leo Meyer (eds). 2007. *Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press.
- Ministry of Environment and Forests (MoEF). 2012. *India—Second National Communication to the United Nations Framework Convention on Climate Change*. New Delhi: MoEF, Government of India. Available at <http://doi.wiley.com/10.1111/j.1467-9388.1992.tb00046.x>.
- Parashar, D.C., A.P. Mitra, P.K. Gupta, J. Rai, R.C. Sharma, N. Singh, S. Koul, et al. 1996. 'Methane Budget from Paddy Fields in India', *Chemosphere*, 33(4): 737–57.
- Progressive Climate Policy Campaign-India. 2009. 'India's Position on Climate Change: Statement Submitted to PM', Progressive Climate Policy Campaign-India (blog), 21 November. Available at <http://progressiveclimatepolycampaign-ind.blogspot.com/2009/11/indias-position-on-climate-change.html>; accessed on 10 June 2019.
- Raghunandan, D. 2002. 'Flop-8: Climate Conference in Delhi', COP-8 blog, *Delhi Science Forum*, 10 November. Available at <https://delhiscienceforum.net/flop-8-climate-conference-in-delhi-by-raghu/>; accessed on 10 June 2019.
- . 2011. 'Durban Climate Agreement: The Morning After', *Delhi Science Forum* (blog), 19 December. Available at <http://www.delhiscienceforum.net/environment/445-durban-climate-agreement-the-morning-after.html>; accessed on 10 June 2019.

- _____. 2012. 'India's Official Position: A Critical View Based on Science', in *Handbook of Climate Change and India*, pp. 170–6. New Delhi: Oxford University Press.
- _____. 2015. 'India's INDC', *Delhi Science Forum* (blog), 14 October. Available at <https://delhiscienceforum.net/indias-indc-for-paris-climate-summit/>; accessed on 22 July 2019.
- Rajamani, Lavanya. 2011. 'Deconstructing Durban', *The Indian Express*, 15 December. Available at <https://indianexpress.com/article/opinion/columns/deconstructing-durban/>; accessed on 10 June 2019.
- Ramachandran, Kaushalya. 2012. 'Assessing Agricultural Vulnerability Due to Climate Change Using NDVI Trends', ResearchGate, Hyderabad. Available at <http://dx.doi.org/10.4172/2157-7625.S1.003>.
- Reynolds, Paul. 2001. 'Kyoto: Why Did the US Pull Out?', *BBC News*, 30 March. Available at <http://news.bbc.co.uk/2/hi/americas/1248757.stm>; accessed on 10 June 2019.
- Sprinz, Detlef. 2001. 'Summary Notes of the 7th Conference of the Parties of the UN Framework Convention on Climate Change', 27 November. Available at https://www.uni-potsdam.de/u/sprinz/doc/UNFCCC_COP_7.Summary.27Nov2001.pdf; accessed on 22 July 2019.
- Vihma, Antto. 2011. 'India and the Global Climate Governance: Between Principles and Pragmatism', *The Journal of Environment & Development*, 20(1): 69–94. Available at <https://doi.org/10.1177/1070496510394325>.

Understanding the 2015 Paris Agreement

Lavanya Rajamani

The international climate change regime has been in evolution for nearly three decades. Over the course of these three decades, notwithstanding seemingly irresolvable differences, parties have negotiated three legally binding instruments—the 1992 United Nations Framework Convention on Climate Change (UNFCCC 1992), the 1997 Kyoto Protocol (KP 1997), and the 2015 Paris Agreement (UNFCCC 2016b)—and numerous decisions under these instruments. These instruments, in particular the KP and the Paris Agreement, represent fundamentally different approaches to the three central issues the international climate change regime has been struggling with since the inception of multilateral negotiations. These issues are: the architecture of climate instruments; the legal form of climate instruments and the legal character of provisions in them; and differentiation among countries, in particular, between developed and developing countries. This chapter explores each of these central issues in turn, with a focus on how the Paris Agreement resolves these issues and represents a step change in the international community's efforts to address climate change.

Central Issues in the Multilateral Climate Change Negotiations

The three central issues in the international climate change regime, namely, architecture, legal form and character, and differentiation, are intricately intertwined. The stronger the legal character of the obligation, the less autonomy states have, and thus greater the differentiation sought by developing countries.

Architecture¹

The multilateral climate change negotiations have, from their inception, experimented with different design and architecture options for the legal instruments that comprise the climate change regime. The KP, with legally binding targets and timetables for developed countries (categorized as Annex I countries in the UNFCCC and Annex B countries in the KP), based on commonly agreed rules, with a strong measurement, reporting, and verification (MRV) system and stringent compliance mechanism, represents the archetypal ‘top-down architecture’. Since it reflects developed country leadership, the KP has enduring significance for developing countries. However, it proved less popular with developed countries, in particular the US, which is not a party to it. The KP’s second commitment period running from 2013 to 2020 proved even less popular with some developed countries, such as Japan and Russia, which withdrew. Although the parties with emission targets were all assessed in compliance at the end of the first commitment period in 2012, they accounted for only 24 per cent of 2010 global emissions (Shishlov, Morel, and Bellassen 2016: 768), and the KP will cover an even smaller fraction of global emissions in its second commitment period, assuming the relevant amendment enters into force.²

¹ This section builds on previous work, notably Bodansky and Rajamani (2018).

² Australia, Belarus, the European Union (EU), Iceland, Kazakhstan, Norway, Switzerland, and Ukraine together accounted for 13.96 per cent of global greenhouse gas (GHG) emissions in 2010, excluding emissions from the land sector. Even if contributions to the global carbon stock or historical

The 2009 Copenhagen Accord, a non-binding instrument, 'take[n] note of' by parties (UNFCCC 2010), reflected the first signs of departure from the Kyoto-like 'top-down' model. The Copenhagen Accord recognized 'the scientific view that the increase in global temperature should be below 2 degree Celsius', but did not prescribe aggregate or individual emission reduction targets, either mid-term or long term, for states. Rather, it required Annex I parties to commit to targets and developing countries to undertake mitigation actions, which were to be inscribed in its Appendices I and II, respectively. A total of 141 parties agreed to be listed in the Copenhagen Accord, and several of them inscribed targets and actions in their appendices. The 2010 Cancun Agreements merely captured these targets and actions in information documents, thus deferring to national autonomy in arriving at commitments/actions in the face of diverse national circumstances and constraints (Bodansky 2011). It rapidly became evident, however, that such a pure bottom-up approach had its limitations. It led to qualified and conditional pre-2020 greenhouse gas (GHG) mitigation pledges of considerable diversity, dubious rigour, and uncertain climate impact, which did not place the world on a trajectory to achieving the 2°C global temperature goal (United Nations Environment Programme [UNEP] 2015).

The negotiations for the Paris Agreement, informed by this experience, sought to design a 'hybrid' instrument. In the build-up to Paris, the 2013 Warsaw decision (UNFCCC 2014) inviting parties to initiate/intensify domestic preparations for Nationally Determined Contributions (NDCs) firmly positioned the bottom-up approach as the starting point for the Paris Agreement (Rajamani 2014). The 2014 Lima Call to Climate Action (UNFCCC 2015) laid out indicative information that the parties were required to provide along

responsibility are factored in, these countries will account only for 24 per cent of global carbon dioxide (CO₂) emissions. Cumulative CO₂ emissions excluding LULUCF (land use, land use change, and forestry) during 1850–2012 (in percentage of world total) were: the EU (24 per cent); Australia (0.01 per cent); Norway (0.001 per cent); and Switzerland (0.002 per cent). See World Resources Institute (n.d.).

with their contributions, in order to promote clarity, transparency, and understanding, thus beginning to circumscribe the discretion available to parties. Ultimately, the Paris Agreement crystallized this emerging hybrid architecture in which bottom-up substance to promote participation (contained in parties' contributions) is combined with a top-down process to promote ambition and accountability.

Legal Form and Character³

In the decade of multilateral negotiations leading up to the Paris Agreement, states had been grappling with the legal form the instrument they were negotiating should take. The options ranged from a soft law instrument, such as a decision taken by the Conference of the Parties (COP), to a legally binding instrument. It is worth noting that there is a distinction between the legal form of an agreement and the legal character of provisions within it. The legal character of a provision refers to the extent to which the provision creates rights and obligations for parties, sets standards for state behaviour, and lends itself to assessments of compliance/non-compliance and the resulting visitation of consequences. Treaties—albeit legally binding instruments requiring state consent (Vienna Convention 1969: Article 11)⁴—typically contain a range of provisions varying in legal character, some with greater legal force and authority than others, and thus some that lend themselves to compliance and others that do not (Abbott et al. 2003: 401; Bodansky 2016: 142; Rajamani 2016b: 342; Werksman 2010: 672, 2016).⁵

³ This section draws on previous work, including Rajamani (2016a, 2016b, 2017).

⁴ Legally binding instruments apply only to those states that have expressed their consent to be bound by means of ratification, acceptance, approval, or accession.

⁵ The legal character of a provision depends on a range of factors, including location (where the provision occurs), subjects (whom the provision addresses), normative content (what requirements, obligations, or standards the provision contains), language (whether the provision uses mandatory or recommendatory language), precision (whether the provision uses contextual, qualifying, or discretionary clauses), and oversight (what institutional mechanisms exist for transparency, accountability, and compliance).

Vulnerable countries on the front lines of climate impact had long argued that anything short of a legally binding instrument would be an affront to the grave crisis threatening their nations. To those likely to lose their nations to rapidly increasing sea-levels, soft law, with all the conceptual fuzziness and state autonomy in implementation that accompanies it, was an unsettling international response. Many developed countries too had favoured a global and comprehensive legally binding instrument under the UNFCCC. The BASIC (Brazil, South Africa, India, and China) countries, concerned about constraints on their development prospects, had initially opposed a legally binding instrument, but in the lead up to the 2011 Durban conference that launched the process to negotiate the Paris Agreement, all but India had placed their weight behind a legally binding instrument. In deference to India's concerns, the Durban Platform launched a new phase of negotiations towards a 'protocol, another legal instrument or agreed outcome with legal force' (UNFCCC 2012)—a formulation that admitted of a range of possibilities for legal form, some of which would be binding but not others (Rajamani 2012).

India's antipathy to a legally binding instrument at this stage was likely due to many overlapping factors, but its position signalled a lack of confidence—whether due to an institutionalized wariness of the international legal system or legal capacity constraints—that India could play a determinative role in shaping the legally binding instrument that would emerge. India could have negotiated an agreement that contained an equitable burden-sharing arrangement, enhanced scrutiny over provision of support by developed countries, as well as soft obligations for developing countries. A sophisticated understanding of the relationship between legal form and character, as introduced earlier, could have enabled India to support a legally binding treaty, while still calibrating the legal bindingness of particular provisions within the treaty to address their concerns and deliver the substantive provisions that were in their interest.

In any case, by the end of the four-year negotiating process that culminated in the Paris conference, India too had softened its stance on the legal form of the instrument that the states were negotiating. A powerful political momentum had built up, due to the efforts of the EU and many vulnerable countries, towards adoption of a legally binding instrument. Also, the reluctance of many countries across

the developed–developing country divide to take on internationally negotiated commitments had led to the emergence and gathering traction of the notion of NDCs—an approach that, by privileging sovereign autonomy, respecting national circumstances, and permitting self-differentiation, significantly reduced the sovereignty costs of a legally binding instrument. Further, due to the efforts of the US and others, there was increasing recognition and acceptance by states of the distinction between the legal form of the instrument and the legal character of NDCs, as discussed earlier. The Paris Agreement thus is a treaty, albeit one with a range of provisions of differing legal character, explored later.

Differentiation

The issue of differentiation between and among developed and developing countries is another site of long-standing conflict in the climate negotiations. At the normative level, this conflict is reflected in varying interpretations of the principle of common but differentiated responsibilities and respective capabilities (CBDR&RC) (Bodansky and Rajamani 2018; UNFCCC 1992: Article 3). At the operational level, this conflict is reflected in the support (or lack thereof) for particular forms of differentiation that the climate instruments have experimented with over the years.

The Durban Platform of 2011 that launched the negotiating process towards the 2015 agreement contained no reference to CBDR&RC, unusually so. Developed countries had sought to downgrade the salience of CBDR&RC by arguing that this principle must be interpreted in the light of contemporary economic realities, but many developing countries were against this proposal. The text of the decision was therefore drafted such that the 2015 agreement was ‘under the Convention’ (UNFCCC 2012: Para 3), thereby implicitly engaging its principles, including CBDR&RC. The Doha and Warsaw decisions in 2012 and 2013, continuing this impasse, contained a general reference to ‘principles’ of the Convention (UNFCCC 2013b: Preambular Recital 7; UNFCCC 2014: Preambular Recital 9), but no specific reference to the CBDR&RC principle. It was only in the Lima Call for Climate Action of 2014, which arrived hot on the heels of a US–China bilateral statement

(Obama 2014: Para 2), that an explicit reference to the CBDR&RC principle, albeit ‘in light of different national circumstances’, was reintroduced in the climate process (UNFCCC 2015: Para 3). This qualification, a compromise arrived at between the US and China, arguably introduces a dynamic element to the interpretation of the CBDR&RC principle. As national circumstances evolve, so too will the common but differentiated responsibilities (CBDR) of states. However, it is also arguable that since ‘respective capabilities’ are based on national circumstances, this qualification merely reiterates an element of the principle.

At an operational level, the CBDR&RC principle permits differential treatment between countries in the fashioning of treaty obligations. Accordingly, the UNFCCC and its KP required developed countries to take the lead in assuming and meeting ambitious GHG mitigation targets. The KP put in place an elaborate institutional architecture to oversee this division of responsibilities, including a compliance system which references the CBDR&RC principle and applies differently to developing and developed countries. This proved problematic for many developed countries. The US’ rejection of the KP in 2001 (Bush 2001), and the eventual withdrawal of many major developed countries from the KP’s second commitment period, can be traced, in part, to concerns about such differentiation in the KP (World Resources Institute n.d.).⁶ In the negotiations since the KP, and in particular since its rejection by the US, there was a gradual erosion of annex-based differentiation and a move towards self-differentiation in the climate regime (Rajamani 2012). This shift occurred in response to consistent demands from developed countries that specific mitigation commitments be extended to developing countries. Many developing countries, for their part, vigorously resisted such efforts; some, including India, came together in a negotiating coalition—the Like-Minded Developing Countries (LMDCs)—primarily to preserve annex-based differentiation (UNFCCC 2013a). In Paris, a compromise was struck on differentiation that bypassed

⁶ The second commitment period of the KP only covers countries representing 11.8 per cent of the 2012 global GHG emissions. This includes the emissions share of Australia, Belarus, EU-28, Iceland, Kazakhstan, Norway, Switzerland, and Ukraine in 2010, excluding LULUCF.

the UNFCCC annexes, built on self-differentiation, and took distinct approaches to differentiation in different issue areas. In contrast to the explicit categorization of countries seen in the UNFCCC and KP annexes, the self-differentiation approach allows parties to define their own commitments, tailor these to their national circumstances, capacities, and constraints, and thus differentiate themselves from each other. The 2009 Copenhagen Accord was built around this type of self-differentiation, and the 2013 Warsaw decision inviting parties to ‘initiate or intensify domestic preparations for their intended nationally determined contributions’ (UNFCCC 2014: Para 2[b]) presaged such a self-differentiated approach in the 2015 Paris Agreement. The development of this approach represented a step change in the climate regime and set the stage for a more nuanced approach to differentiation in the Paris Agreement.

The 2015 Paris Agreement

The 2015 Paris Agreement was adopted after years of deeply contentious multilateral negotiations. As mentioned earlier, it represents a step change in the climate change regime, reflecting a hybrid approach to: architecture, combining ‘bottom-up’ NDCs with a ‘top-down’ oversight system; legal form and character, containing a spread of provisions of differing legal character; and differentiation, containing a nuanced application of the CBDR&RC principle.

Architecture and Core Obligations

The Paris Agreement resolves to confine the increase in global average temperature to ‘well below 2°C’ above pre-industrial levels and to pursue efforts towards a 1.5°C temperature limit (UNFCCC 2016b: Article 2[1]). The world is not currently on a pathway to 1.5°C; indeed, it is far from it. Such a pathway would dramatically shrink the remaining carbon space, with troubling implications for countries like India that have yet to lift the vast majority of their citizens from the scourge of poverty (Jayaraman and Kanitkar 2016). Nevertheless, the ‘well below 2°C’ target and the aspirational 1.5°C goal sets an ambitious direction of travel for the climate regime to be achieved, *inter alia*, through global peaking of GHG emissions as

soon as possible, and rapid reductions thereafter (UNFCCC 2016b: Article 4[1]).

In order to meet the temperature goal, parties are subject to binding obligations of conduct in relation to preparing, communicating, and maintaining NDCs, as well as in taking domestic measures (Falk 2016). Parties are also required to communicate their contributions every five years (UNFCCC 2016b: Article 4[9]); and while doing so, they have to provide the information necessary for clarity, transparency, and understanding (UNFCCC 2016b: Article 4[8]). These provisions are phrased in mandatory terms ('shall'), and thus constitute binding obligations for parties. In addition to these obligations, the Paris Agreement sets normative expectations that for every five-year cycle, parties must put forward contributions that represent a progression on the last and reflect their highest ambition possible. There is also an expectation that developed countries will lead (UNFCCC 2016b: Article 4[4]).

In addition to mitigation, parties are obliged to engage in adaptation planning and implementation of adaption actions, and are encouraged to submit and update periodic adaptation communications (UNFCCC 2016b: Article 7). The Paris Agreement also includes a provision on 'loss and damage' (UNFCCC 2016b: Article 8), signalling both that the issue is within the scope of the Paris Agreement and that it is to be addressed independently of adaptation.

The Paris Agreement's hybrid approach preserves state autonomy in the determination of their NDCs, but strengthens oversight of these contributions through a robust transparency system, a global stocktake process, and a compliance mechanism. In so doing, it limits the self-serving nature of self-determination and generates normative expectations. The 'transparency framework for action and support' places extensive informational demands on all parties (UNFCCC 2016b: Article 13), and subjects information on mitigation and finance to close scrutiny (UNFCCC 2016b: Article 13[11]).

A complementary 'global stocktake' every five years is intended to assist parties in determining if national efforts add up to what is necessary to limit temperature increase to well below 2°C (UNFCCC 2016b: Article 2[1]). The global stocktake is required to assess collective progress 'in the light of equity and the best available science' (UNFCCC 2016b: Article 14[1]). The inclusion of 'equity' was a

negotiating coup for several developing countries, in particular the Africa Group, that had long championed the need to consider parties' historical responsibilities, current capabilities, and development needs in setting expectations for NDCs (UNFCCC 2013c). It is unclear at this point how equity, yet to be defined in the climate regime, will be understood and incorporated in the global stocktake process, but its inclusion leaves the door open for a dialogue on equitable burden sharing. The Paris Agreement also establishes a mechanism to facilitate implementation of, and promote compliance with, its provisions (UNFCCC 2016b: Article 15).

Legal Character

The Paris Agreement, albeit a legally binding instrument, contains provisions that are spread across the spectrum of legal character (Rajamani 2016b). At one end of the spectrum are 'hard law' (Kiss and Shelton 2007: 10–13) provisions that create rights and obligations for parties, set standards, and lend themselves to assessments of compliance and non-compliance. This is, for instance, the case with individual ('each Party') obligations, framed in mandatory terms ('shall'), with clear and precise normative content and no qualifying or discretionary elements. Article 4(2), stating that 'Each Party shall prepare, communicate and maintain' successive NDCs, is an example of such an obligation. This obligation is one of conduct rather than of result. Thus, the central obligation in relation to mitigation is to submit NDCs, not to achieve them.

In the middle of the spectrum are 'soft law'⁷ (Handl 1988: 371) provisions that identify actors ('each Party' or 'all Parties'), set standards, albeit frequently with qualifying and discretionary elements and in recommendatory terms ('should' or 'encourage'). Article 7(10), stating that 'Each Party should, as appropriate, submit and update periodically an adaptation communication....', is an example.

⁷ The term 'soft law' is used to refer to 'international prescriptions that are deemed to lack requisite characteristics of international normativity', but which, nevertheless, 'are capable of producing certain legal effects'.

At the other end of the spectrum are provisions lacking in normative content that capture understandings between parties, provide context or offer a narrative, best characterized as non-law, even though they exist in the operational part of a legally binding instrument. Article 6(8), stating that ‘parties recognize the importance of integrated, holistic and balanced non-market approaches being available to Parties’, is an example. These categories—hard, soft, and non-law—are imprecise and fluid, and there is no bright line between them. The Paris Agreement contains a mix of hard, soft, and non-law elements between which there is dynamic interplay. Each provision contains a unique blend of elements of legal character, and thus occupies its own place in the spectrum from hard law to non-law. The combination of elements in each provision is a reflection of the demands of the relevant issue area as well as the particular politics that drove its negotiation.

Differentiation⁸

The Paris Agreement neither creates explicit categories of parties nor tailors commitments to categories of parties as the UNFCCC and the KP do. Rather, it tailors differentiation to the specificities of each issue area it addresses: mitigation, adaptation, finance, technology, capacity building, and transparency (Rajamani 2016a). In effect, this approach has resulted in different forms of differentiation in different issue areas.

In the area of mitigation, for instance, the Paris Agreement combines self-differentiation with normative expectations of ‘progression’ and ‘highest possible ambition’ for all countries, and of leadership for developed countries. In contrast, in the area of transparency, differentiation is tailored to capacities, by providing flexibility to those developing countries ‘that need it in the light of their capacities’ (Bodansky, Brunnée, and Rajamani 2017: 231–8).

The finance provisions of the Paris Agreement are perhaps the most UNFCCC-like in the form of differentiation they embody. Developed countries are required in mandatory terms (‘shall’) to

⁸ This section draws on Rajamani (2016a).

provide financial resources to developing country parties ‘in continuation of their existing obligations under the Convention’ (UNFCCC 2016b: Article 9[1]). Developed countries are also required to continue to take the lead in mobilizing climate finance (UNFCCC 2016b: Article 9[3]). This obligation is given concrete content in the decision accompanying the Paris Agreement that captures an agreement to continue the collective developed countries’ mobilization goal through 2025, and to set before 2025, a ‘new collective quantified goal from a floor of USD 100 billion per year’ (UNFCCC 2016c: Para 53).

This fine-grained operationalization of CBDR&RC in the light of different national circumstances (CBDR&RC-NC) in the Paris Agreement proved sufficient to secure agreement, but it nevertheless left several lingering equity concerns unaddressed (Jayaraman and Kanitkar 2016). For instance, the Paris Agreement uses the terms ‘developed’ and ‘developing’ countries without either defining them or using lists, as the UNFCCC and KP do. Further, in relation to transparency, parties will need to consider which developing countries need flexibility, what kind of flexibility will be provided (UNFCCC 2016c: Para 89),⁹ and for how long. In these and other areas, the devil of differentiation will lie in the details of the post-Paris negotiations.

The Paris Agreement reflects an innovative approach to global climate change regulation, one that reflects a step change from previous approaches that, albeit seemingly rigorous, had deterred widespread participation. In seeking to balance breadth of coverage with depth of commitments, the Paris Agreement chose to combine ambitious long-term goals with national determination of contributions, binding obligations of conduct, and a rigorous oversight system. The NDCs submitted by parties to the Paris Agreement, 170 as of May 2018 (UNFCCC n.d.), cover a wide range, signalling broad participation across countries.

⁹ This specifies flexibility in ‘scope, frequency, and level of detail of reporting, and in the scope of review’.

The Paris Agreement's aspiration to universal participation, however, was dealt a body blow by the US announcement of its withdrawal from the Agreement (Liptak and Acosta 2017). The US will remain a party to the Paris Agreement until November 2020, according to the rules which prescribe a three-year waiting period and an additional year for actual withdrawal (UNFCCC 2016b: Article 28). If and when the US withdrawal takes effect, as it is the world's second-largest GHG emitter and largest economy, the challenges of meeting the Paris Agreement's goals are likely to substantially increase. Moreover, in its statement of intent, the US indicated an interest in identifying more favourable terms, implying a possible downgrade of its NDCs (US Department of State 2017). Although such backsliding on NDCs is not consonant with parties' commitments and attendant normative expectations (including 'progression') under the Paris Agreement (Rajamani and Brunnée 2017), it does indicate the potential risk of the careful Paris consensus unravelling. A risk, however, that appears to be receding as no other country has followed the US lead thus far.

The countries that remain committed to the Paris Agreement concluded the bulk of the Paris Rulebook in December 2018. The Rulebook, balancing prescriptiveness with flexibility, fleshes out the skeletal Paris Agreement, and operationalizes processes established in the Paris Agreement, such as in relation to transparency, stocktake, implementation, and compliance. In doing so the Rulebook strengthened the Paris Agreement's oversight system, of critical importance given the 'bottom-up' nature of Parties' NDCs do not add up to what is required to meet the long-term temperature goal identified in the Paris Agreement.

There are variations among NDCs, *inter alia*, in relation to the nature of mitigation targets (ranging from absolute, deviations from business-as-usual to intensity targets, and policies and actions); scope/coverage of gases and sectors; reference points; whether they are conditional or unconditional, or contain elements of both; and justifications for how their NDC is 'fair and ambitious'. Although such variations reflect the diversity of national circumstances and must be accommodated in the Agreement, at least initially, these self-selected contributions accompanied by selectively chosen information and self-serving narratives foster uncertainty and militate against comparability and assessment. In any case,

current NDCs, even assuming they are unconditionally implemented, place us on a trajectory to 2.6–3.2°C temperature increase (UNFCCC 2016a).

The Paris Agreement, designed, unlike the KP, to foster widespread participation even at the cost of less stringent commitments, depends for its effectiveness on the ability of the regime to deliver ambition over time. It remains to be seen if the Agreement, as operationalized through the Rulebook, and the widespread actions it has catalysed among state, non-state, and sub-state actors, will deliver such ambition in time to bend the curve of emissions towards the Agreement's temperature goals.

References

- Abbott, Kenneth W., Robert O. Keohane, Andrew Moravcsik, Anne-Marie Slaughter, and Duncan Snidal. 2003. 'The Concept of Legalization', *International Organization*, 54(3): 401–19. Available at <https://doi.org/10.1162/002081800551271>.
- Bodansky, Daniel. 2011. 'A Tale of Two Architectures: The Once and Future UN Climate Regime', *Arizona State Law Journal*, 43(December): 697–712. Available at <https://dx.doi.org/10.2139/ssrn.1773865>.
- . 2016. 'The Legal Character of the Paris Agreement', *Review of European, Comparative and International Law*, 25(2): 142–50. Available at <https://doi.org/10.1111/reel.12154>.
- Bodansky, Daniel, Jutta Brunnée, and Lavanya Rajamani. 2017. *International Climate Change Law*. Oxford: Oxford University Press.
- Bodansky, Daniel and Lavanya Rajamani. 2018. 'Evolution and Governance Architecture of the Climate Change Regime', in Detlef Sprinz and Urs Luterbacher (eds), *International Relations and Global Climate Change: New Perspectives*, pp. 13–65. Massachusetts: MIT Press.
- Bush, George W. 2001. 'Text of a Letter from the President to Senators Hagel, Helms, Craig, and Roberts', The White House. Available at <https://georgewbush-whitehouse.archives.gov/news/releases/2001/03/20010314.html>; accessed on 21 April 2018.
- Falk, Richard. (2016). "'Voluntary" International Law and the Paris Agreement', 16 January. Available at <https://richardfalk.wordpress.com/2016/01/16/voluntary-international-law-and-the-paris-agreement/>; accessed on 21 May 2018.
- Handl, Gunther F. 1988. 'A Hard Look at Soft Law: Remarks by Professor Handl', *Proceedings of the Annual Meeting (American Society of International Law)*, 82: 371–95.

- Jayaraman, T. and Tejal Kanitkar. 2016. 'The Paris Agreement', *Economic & Political Weekly*, 51(3): 10–13. Available at http://www.epw.in/system/files/pdf/2016_51/3/CM_LI_3_The%20Paris%20Agreement.pdf; accessed on 7 June 2019.
- Kiss, Alexandre and Dinah L. Shelton. 2007. *Guide to International Environmental Law*. Boston: Martinus Nijhoff Publishers.
- Kyoto Protocol (KP). 1997. 'Kyoto Protocol to the United Nations Framework Convention on Climate Change', *United Nations Treaty Series*, 2303: 148.
- Liptak, Kevin and Jim Acosta. 2017. 'Trump on Paris Accord: "We're Getting Out"', *CNN*, 2 June. Available at <https://edition.cnn.com/2017/06/01/politics/trump-paris-climate-decision/index.html>; accessed on 7 June 2019.
- Obama, Barack. 2014. 'US–China Joint Announcement on Climate Change', The White House. Available at <https://obamawhitehouse.archives.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change>; accessed on 21 April 2018.
- Rajamani, Lavanya. 2012. 'The Durban Platform for Enhanced Action and the Future of the Climate Regime', *International and Comparative Law Quarterly*, 61(2): 501–18. Available at <https://doi.org/10.1017/S0020589312000085>.
- . 2014. 'The Warsaw Climate Negotiations: Emerging Understandings and Battle Lines on the Road to the 2015 Climate Agreement', *International and Comparative Law Quarterly*, 63(3): 721–40. Available at <https://doi.org/10.1017/S0020589314000311>.
- . 2016a. 'Ambition and Differentiation in the 2015 Paris Agreement: Interpretative Possibilities and Underlying Politics', *International and Comparative Law Quarterly*, 65(2): 493–514. Available at <https://doi.org/10.1017/S0020589316000130>.
- . 2016b. 'The 2015 Paris Agreement: Interplay between Hard, Soft and Non-Obligations', *Journal of Environmental Law*, 28(2): 337–58. Available at <https://doi.org/10.1093/jel/eqw015>.
- . 2017. 'India's Approach to International Law in the Climate Change Regime', *Indian Journal of International Law*, 57(2): 1–23. Available at <https://doi.org/10.1007/s40901-018-0072-0>.
- Rajamani, Lavanya, and Jutta Brunnée. 2017. 'The Legality of Downgrading Nationally Determined Contributions under the Paris Agreement: Lessons from the US Disengagement', *Journal of Environmental Law*, 29(3): 537–51. Available at <https://doi.org/10.1093/jel/eqx024>.
- Shishlov, Igor, Romain Morel, and Valentin Bellassen. 2016. 'Compliance of the Parties to the Kyoto Protocol in the First Commitment Period', *Climate Policy*, 16(6): 768–82. Available at <https://doi.org/10.1080/14693062.2016.1164658>.

- United Nations Environment Programme (UNEP). 2015. *The Emissions Gap Report 2015*. Available at http://wedocs.unep.org/bitstream/handle/20.500.11822/16518/EGR_2015_advanceCopy.pdf?sequence=1&isAllowed=y, accessed 21 May 2018.
- United Nations Framework Convention on Climate Change (UNFCCC). n.d. 'NDC Directory (Interim)'. Available at <http://www4.unfccc.int/ndcregistry/Pages/Home.aspx>; accessed on 17 May 2018.
- . 1992. 'United Nations Framework Convention on Climate Change', *United Nations Treaty Series*, 1771: 107.
- . 2010. 'The Copenhagen Accord', Decision 2/CP.15, FCCC/CP/2009/11/Add.1, p. 4.
- . 2012. 'Establishment of an Ad-Hoc Working Group on the Durban Platform for Enhanced Action', Decision 1/CP.17, FCCC/CP/2011/9/Add.1, p. 2. Available at <https://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf>; accessed on 7 June 2019.
- . 2013a. 'Ad-Hoc Working Group on the Durban Platform for Enhanced Action (ADP): Submission by the Like-Minded Developing Countries on Climate Change (LMDC)', Decision 1/CP.17. Available at https://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp_lmhc_workstream_1_20130313.pdf; accessed on 22 May 2018.
- . 2013b. 'Agreed Outcome Pursuant to the Bali Action Plan', Decision 1/CP.18, FCCC/CP/2012/8/Add.1, p. 3. Available at <https://unfccc.int/resource/docs/2012/cop18/eng/08a01.pdf>; accessed on 7 June 2019.
- . 2013c. 'Submission by Swaziland on Behalf of the African Group under Workstream I of the ADP'. Available at https://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp_african_group_workstream_1_20131008.pdf, accessed on 21 April 2018.
- . 2014. 'Further Advancing the Durban Platform: Warsaw Decision', Decision 1/CP.19, FCCC/CP/2013/10/Add.1, p. 3.
- . 2015. 'Lima Call for Climate Action', Decision 1/CP.20, FCCC/CP/2014/10/Add.1, p. 2.
- . 2016a. 'Aggregate Effect of the Intended Nationally Determined Contributions: An Update', Synthesis Report by the Secretariat, FCCC/CP/2016/2. Available at <https://unfccc.int/resource/docs/2015/cop21/eng/07.pdf>; accessed on 7 June 2019.
- . 2016b. 'Adoption of the Paris Agreement', Decision 1/CP.21, FCCC/CP/2015/10/Add 1, p. 2, Annex: Paris Agreement.
- United Nations Framework Convention on Climate Change (UNFCCC). 2016c. 'Adoption of the Paris Agreement', Decision 1/CP.21, FCCC/CP/2015/10/Add 1, p. 2.

- United States (US) Department of State. 2017. 'Communication Regarding Intent to Withdraw from Paris Agreement'. Available at <https://www.state.gov/r/pa/prs/ps/2017/08/273050.htm>; accessed on 21 April 2018.
- Vienna Convention. 1969. 'Vienna Convention on the Law of Treaties', *United Nations Treaty Series*, 1155: 331.
- Werksman, Jake. 2010. 'Legal Symmetry and Legal Differentiation under a Future Deal on Climate', *Climate Policy*, 10(6): 672–7. Available at <https://doi.org/10.3763/cpol.2010.0150>.
- . 2016. 'The Legal Character of International Environmental Obligations in the Wake of the Paris Climate Change Agreement', Brodies Environmental Law Lecture Series. Available at https://www.biicl.org/documents/887_brodieslectureonthelegalcharacteroftheparisagreementfinalbiccledinburgh.pdf?showdocument=1; accessed on 7 June 2019.
- World Resources Institute. n.d. 'Climate Watch'. Available at <https://www.climatewatchdata.org/>; accessed on 18 April 2018.

India and Paris

A Pragmatic Way Forward

Ajay Mathur

The Paris Agreement: A Game Changer

The Paris Agreement was a game changer on many fronts. It signalled the objective of the global community to keep global temperature increase to below 2°C; introduced a bottom-up approach to emissions reductions in a multilateral format; accepted the principle of progressive, enhanced ambition by countries in order to meet the global objective; and brought to the fore the need for transparency in actions by all countries bound by a common rulebook. Notably, the pledges that are made by countries are not legally binding in an international context.

These are a remarkable set of accomplishments in a world where the remaining carbon budget is limited, and the allocation of which has been directly or indirectly at the heart of carbon negotiations for the last two decades. From the point of view of India, and other developing countries, all facing the challenge of providing access to electricity and clean cooking fuels to large numbers of people with

limited ability to pay for them, limiting carbon emissions was always possible if adequate international finance and transfer of zero-carbon energy technologies was available.

It has also been the position of India and other countries of the G77 and China group that the developed countries, which contributed to the creation of the large stock of carbon dioxide (CO₂) in the global environment, had the responsibility to provide this finance and technology to the developing countries which still have to enhance their energy use (and emissions), as a necessary prerequisite for enhancing the quality of life of their citizens. In the negotiations (and contrary to the text of the United Nations Framework Convention on Climate Change [UNFCCC]), the developed countries have strenuously objected to their 'responsibility' to provide the required finance and technology to developing countries.

However, this started changing at the 13th Conference of the Parties (COP 13) in Bali in 2007, where India, on behalf of G77 and China, prevailed in ensuring that the road map for long-term cooperative action stated that mitigation action by developing countries must be accompanied by technological, financial, and capacity-building support, subject to being measurable, reportable, and verifiable. This was a significant step forward for India and the G77/China, as well as for developed countries, inasmuch as it laid out a framework for mitigation actions by all countries. At Bali, another significant step forward for India and G77/China, with Indian and Chinese leadership, was the agreement on the creation of the Adaptation Fund, a mechanism that had been unresolved for many years.

The confidence and leadership that India displayed at Bali was, in a large sense, based on domestic actions during the past year, which included the designation of Shyam Saran as prime minister's special envoy on climate change, the creation of the Prime Minister's Council on Climate Change, and the preparation and release of the National Action Plan on Climate Change (NAPCC) which initiated eight missions linking climate and development objectives. This was the first time in India that the prime minister and the Prime Minister's Office provided direct leadership to the climate change agenda, and created a broad-based structure to enable climate issues to be mainstreamed in the work of the ministries where mitigation or adaptation actions were needed to address climate change.

The inter-ministerial discussions in India also provided additional urgency for India to insist that the Bali road map not be confined only to mitigation, but also include three more pillars of adaptation, technology, and finance.

This agenda continued to guide India, and by COP 17 in Durban in 2011, apart from the Adaptation Fund created at Bali, the Green Climate Fund (GCF) and the Technology Mechanism, including the Climate Technology Centre and Network, were created.

However, an agreement on mitigation kept eluding the parties to the UNFCCC. Quite significantly for India, the Bali agreement on the principles of developing country engagement could not be converted into a negotiated agreement; instead, at COP 15 in Copenhagen in 2009, an agreement was reached between leaders (initially between the leaders of the United States [US] and the BASIC [Brazil, South Africa, India, and China] countries, which later went on to include European Union [EU] leaders as well). The agreement could not be adopted by the COP, which viewed it as an extraneous text as it was not based on any draft developed by it. Instead, the COP only noted the agreement.

In hindsight, the Copenhagen COP revealed several tectonic changes that were occurring in the dynamics of global action to address climate change. The first was the centrality of the BASIC countries to the process. The second was the importance of ensuring that the COP ‘owned’ the process through which agreements and decisions were reached. The third, and perhaps the most important, was the evolving understanding that a Kyoto Protocol-type top-down emissions reduction agreement was no longer possible. However, it was several years before each of these was recognized. Indeed, probably and somewhat paradoxically, it was clear to all parties only by COP 17, held in Durban in December 2011, that the creation of certain bodies—such as the GCF and the Technology Mechanism—alone could not move the agenda to address climate change any further. While India vigorously continued to insist that the provision of technology and finance were key to its accelerated actions to address climate change, in private it was agreed that it was difficult to foresee a future in which these transfers would actually occur at scale. Consequently, the intellectual environment was ripe to absorb alternate approaches to the global issue.

The Evolution of India's Expectations in the Negotiations

India had long maintained that energy efficiency, promotion of renewables, and appropriate forestry actions—all of which were globally seen as the main climate change mitigation actions—were important for its own development, and for non-climate reasons. Consequently, in each of these sectors, strong government policy was progressively adopted, at least since the mid-1990s, including parliamentary enactments, creation of ministries and agencies, and dedicated budget lines for these activities. Much of the early action in these sectors was driven by subsidies provided by the Government of India as the high cost of renewable energy and energy-efficient technologies was observed to be a major barrier to their large-scale adoption, and consequently international grants which brought down the prices of renewables and energy-efficient technologies were seen as being crucial to further their accelerated adoption.

However, in the years between 2012 and 2015, business models and action frameworks changed as India moved away from the subsidy-based approach. In two areas, namely, light-emitting diode (LED) bulbs and photovoltaics (PV)-based solar electricity, India experimented with a new business model based on demand aggregation coupled with successive rounds of competitive bulk procurement.¹ In both cases, the results were clear early in the process: India's large and expanding market was able to effectively absorb the new technologies and their initially high prices, while simultaneously prices decreased as volumes increased. This learning led to a feeling—unevenly spread across various stakeholders—that the large amount of energy generation and energy-efficient infrastructure (and forest plantations) that were yet to be put in place presented a huge opportunity for the increased adoption, and simultaneous price reduction, of low- and zero-carbon options that were, in any case, desirable for a range of development goals.

It also led to ambitious upscaling of domestic renewable energy and energy-efficiency targets, and through tortuous domestic

¹ 'India's LED Lighting Story', 14 November 2017. Available at <https://cprindia.org/news/6527>.

discussions, to the possibility of ambitious climate pledges. The successes, especially in PV-based solar electricity sector, also suggested that the Indian business model (of demand aggregation and bulk procurement) could be of benefit to other countries, especially developing countries.

In the context of climate pledges by several countries, India had already, in 2010, pledged to reduce the carbon intensity of its economy by 20–5 per cent in 2020 compared to that of 2005.² Through this pledge, India signalled its willingness to focus on enhancing the carbon use efficiency of its economy, if not in reducing the absolute level of its carbon emissions.

By the time the concept of Intended Nationally Determined Contributions (INDCs) was agreed to in the Warsaw COP of 2013, it was clear that the Indian INDC would also be framed in terms of carbon intensity reduction. The increasing emphasis on the growth of renewable energy also pushed in the same direction. As a result, when India submitted its INDC on 2 October 2015, prior to the Paris negotiations, it had eight pledges, three of which (focusing on carbon intensity reduction, enhancement of the share of non-fossil fuel in electricity generation, and increase in the carbon sink due to afforestation and tree cover) were quantified, largely due to the successes of the domestic initiatives in renewables, energy efficiency, and forestry, the three missions of the 2007 NAPCC which had started seeing success by 2015.

Thus, three thought processes and learnings came together in the 2012–15 time frame: (i) the crystallization of the thought that action was needed by all countries, including India (largely because it was seen that significant climate-related domestic action, with very strong development benefits, was possible at a low incremental cost that India could absorb because of the development gains); (ii) India could contribute by lowering its carbon intensity (though not by reducing its absolute carbon emissions); and (iii) there were opportunities to use the size of the Indian market to enhance the rate of

² Letter from the joint secretary, Ministry of Environment and Forests, Government of India, dated 30 January 2010. Available at https://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/indi-acphaccord_app2.pdf.

adoption and simultaneously enable price reduction of low-carbon technologies as well to strengthen markets for these technologies in other developing countries. These led India to believe that a universal agreement to which it agreed would have to be based on self-prepared pledges by individual countries.

The Paris Negotiations

At Paris, India was therefore ready to move towards an agreement based on pledges by countries. However, assessments carried out just prior to the Paris negotiations indicated that the INDCs of all countries put together would lead to a global temperature rise of 2.7°C–3.4°C.³ This was at odds with the thinking that the temperature rise should be less than 2°C, with the Small Island Developing States advocating that the global temperature rise should be less than 1.5°C. This obviously implied that the INDCs were collectively inadequate and had to be revised at some point and made more stringent.

At the same time, as the Paris negotiations began, India was bombarded with negative publicity as it was being portrayed as a major user of coal who would continue to use coal despite climate change concerns. It was also portrayed as a major roadblock in the negotiations. At Paris, therefore, India adopted a two-pronged approach: one was to work with other countries to develop an agreement within which self-prepared Nationally Determined Contributions (NDCs) could progressively be made more stringent without infringing on national sovereignty; and the second was to showcase the growing share of renewables and energy-efficient technologies in India's energy mix. By the end of the first week of negotiations, a broad agreement on a long-term path had been developed, involving cycles of NDCs, punctuated by global stocktakes, which would inform the global community about the stringency needs for the next cycle of NDCs. Additionally, most of the criticism of India's continued coal use had abated as information about the increasing

³ See 'Fair Shares: A Civil Society Equity Review of INDCs', *Civil Society Review Report*, November 2015. Available at https://civilsocietyreview.org/wp-content/uploads/2015/11/CSO_FullReport.pdf.

share of renewables and energy efficiency, and of the ambitious targets, became clear.

The final key negotiations at Paris related to transparency measures and global objective. The transparency measures were seen as 'confidence-building measures' through which all countries would periodically declare their progress with respect to their NDCs. Most importantly, it was agreed that these declarations would be based on pre-agreed guidelines; the rulebook for which was to be agreed upon by the parties. Finally, the contentious issue of the global objective was agreed to, though with a degree of ambiguity. It was agreed that the global temperature rise would be much lesser than 2°C and towards 1.5°C.⁴ Whilst ambiguous on the debate between 1.5°C and 2°C, the agreement that the temperature rise should be limited to less than 2°C was broadly (and possibly universally) accepted.

Paris Agreement as a Paradigm Change

The Paris process reflects paradigm changes at several levels in India.

The first has been in terms of mainstreaming climate actions in the development agenda and frameworks. The NDCs have provided a basis for this mainstreaming, which is now being incorporated both in government plans as well as in corporate investment decisions.

The second has been India's diplomatic positioning. Apart from the negotiating approach, Paris also provided India with an opportunity to showcase a new diplomatic configuration, reflective of the new reality in which it is a stakeholder both in the traditional developing world, the G77, and in the large economies, the G20. The International Solar Alliance (ISA), launched at Paris together with France, has not only sought out developing countries (located between the Tropic of Cancer and the Tropic of Capricorn) as its primary members and beneficiaries of a common solar future, but has also sought the developed countries as partners to help achieve the ISA goals. The Indian diplomatic efforts in reaching out to

⁴ Paris Agreement, UNFCCC. 2015. Available at https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

developing countries, in particular, in order to convince them to join the ISA reflect the new geopolitical reality of India straddling the G77 and G20 blocs, as well as its stature in enabling the formation of a new intergovernmental organization.

The third has been that the agreements at Paris have provided India (and the world) with a pragmatic way of moving ahead. In the first instance, all countries pledge what they can do. It is commonly believed that almost all countries (including those who have subsequently declared their intention to step out of the Paris Agreement) would meet their pledges because these have created a political, economic, and technological momentum for action. Also, countries, like individuals, are likely to fulfil the pledges that they have made on their own accord. Consequently, as countries achieve the pledges that they have made in their first NDCs, they will gain the confidence of achieving their goals, and therefore be confident of achieving even more in the next cycle of NDC pledges. Through their actions and the declarations of their progress, countries also enable other countries to trust them to achieve their pledges. This global virtuous cycle of trust and confidence—which seems to be surviving the US move to distance itself from the Paris Agreement—is probably the greatest achievement enabled by the Paris Agreement.

Making Sense on Its Own Terms

India in the HFC and Aviation Negotiations

Arunabha Ghosh

This chapter covers India's engagement with two recent deals related to climate change that were not carried out under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC). On 6 October 2016, 191 countries participating in the 39th general assembly of the International Civil Aviation Organization (ICAO) agreed to the first-ever industry-specific deal to reduce emissions. Also, after seven years of negotiations, on 15 October 2016, 197 countries reached a historic agreement in Kigali, Rwanda, to amend the Montreal Protocol on Substances that Deplete the Ozone Layer, and phase down hydrofluorocarbons (HFCs). Coming soon after the Paris Agreement on climate change, these deals were products of a season of climate negotiations. Earlier such attempts had failed. Why then did they succeed in 2016? What compromises were struck? How did India win or lose?

These deals truly matter. First, they deal with greenhouse gases (GHGs) or sectors that had, thus far, avoided strong regulatory

control. Second, both are concerned with projected emissions rather than current emissions or historical responsibility. Third, in these deals, historical distinctions between developed and developing countries have been blurred. Fourth, they offer the prospect of greater transparency, verifiability, and enforcement.

This chapter discusses points of contestation between negotiating parties. An important common factor was the threat of unilateral action, outside a multilateral framework, such as the European Union (EU) proposing to include aviation in its Emissions Trading Scheme (ETS), or refrigerant standards changing in the American or European markets. Although these measures would impact commercial interests, the chapter also considers how domestic conditions were changing in India and creating new constituencies in favour of a deal. The chapter's central focus is on the in-country analysis and consultations in recent years, which allowed for a more proactive—rather than merely defensive—approach to the HFC (and partly aviation) negotiations. The deals could not have been possible if India had not made sense of the science, the technological alternatives, the interests of varied groups, and the economic impact on its own terms.

Contestations

HFCs, primarily used for commercial, residential, and automotive refrigeration, are GHGs that are several hundred (and in some cases, several thousand) times more potent than carbon dioxide (CO₂) in contributing to climate change. Though meant to replace hydrochlorofluorocarbons (HCFCs) in order to protect the ozone layer, there was growing fear that runaway HFC emissions would undermine or negate efforts to mitigate CO₂ emissions (Sridhar and Chaturvedi 2017).

Globally, HFC consumption was projected to increase five to nine times during 2010–50, with the largest growth in developing country markets (Velders et al. 2009, 2015). Also, it was predicted that HFCs could contribute almost 20 per cent of total global warming by 2050 (Xu et al. 2013). While global studies warned of the impending risks, there was limited awareness or clarity in India about the challenge, the potential of natural refrigerants (Bhattacharyya 2010;

Padalkar 2012), the scale and growth rate of emissions, and costs of phasing down HFCs.

HFC Negotiations, and Pushback, at Many Forums

In July 2009, G8 countries said they would ‘work with ... partners to ensure ... HFC emissions reductions ... under the appropriate framework’ (G8 Declaration 2009: Para 66). The same month, Mauritius and the Federated States of Micronesia proposed that the Montreal Protocol be amended to regulate HFCs.

At the Montreal Protocol’s annual meeting in November, many developing countries opposed the proposal. India wanted existing implementation issues with HCFC phase out to be resolved first. Malaysia felt that, without alternatives, any discussion on HFCs was premature. China, India, and the Dominican Republic, among others, wanted HFCs to be handled under the UNFCCC. Another amendment proposal, by the US, Canada, and Mexico, was eventually withdrawn. The final decision omitted references to HFCs and replaced them with ‘environmentally sound alternatives’ (*Earth Negotiations Bulletin* 2009).

The pressure, nonetheless, kept mounting. In November 2011, the Bali Declaration called on parties to the Protocol to ‘pursue ... effective means of achieving the transition to low global warming potential alternatives to ozone depleting substances’ (Montreal Protocol 2011). In February 2012, the Climate and Clean Air Coalition was launched by the United Nations Environment Programme (UNEP) and six countries—Bangladesh, Canada, Ghana, Mexico, Sweden, and the US—to improve air quality and target short-lived climate pollutants. India refused to join this.

Tensions came to a head in 2013. In September, then Indian Prime Minister Manmohan Singh and then US President Barack Obama agreed (bilaterally and at the G20 Summit) to use the expertise and institutions of the Montreal Protocol to phase down HFCs and report emissions under the UNFCCC. The prime minister chose to keep both options open (UNFCCC and Montreal Protocol) and acted in concert with other G20 countries. Within a few weeks, however, India opposed discussing amendments in the Montreal Protocol.

India's negotiators scuttled a political deal for four reasons. They feared that developed countries would ignore action on CO₂, which was the much-larger and longer-lasting GHG. Second, there was concern that the UNFCCC would be bypassed, while not guaranteeing financial support for India to transition to alternatives. In fact, there was a higher chance of getting money through the Protocol's Multilateral Fund (MLF) than through the UNFCCC. Third, although historically China and India had opposed HFC discussions under the Montreal Protocol, recent developments made India unsure of China's strategy. China had agreed to work with the US on HFC phase-down negotiations in June 2013 (The White House 2013). In the October 2013 Montreal Protocol meetings, when India opposed discussion on HFCs, China remained silent. By not overtly supporting India's position, China signalled that its own position could shift. A side deal between China and the US would put undue pressure on India to yield. Fourth, critics argued that the prime minister had not gained prior support from negotiators at the Ministry of Environment and Forests. For the prime minister, it was a strategic decision at the G20 and for India-US bilateral relations. But line ministry officials, intent on keeping a hard line in HFC negotiations, undermined the prime minister's approach.

The negotiators worried that they were being forced into a corner. The G8 and G20 declarations, the amendment proposals, plurilateral coalitions, and bilateral announcements were negotiating tactics. However, the rules were uncertain and India's understanding of the issues was inchoate. Although bilateral and plurilateral deals might have allowed India to carve out flexibility, it reflexively preferred the relative certainty of the UNFCCC process.

Logjam on the Aviation Runway

The aviation sector, at the beginning of the twenty-first century, accounted for only 2 per cent in global emissions, but 4–9 per cent of anthropogenic global warming (Lee et al. 2009). International aviation emissions had grown 76 per cent during 1990–2012, double the average growth in emissions from the rest of the global economy (UNFCCC 2014).

The UNFCCC did not have any direct mandate to regulate aviation emissions. The responsibility lay with ICAO. The Convention on International Civil Aviation (Chicago Convention), which established ICAO in 1947, had two core principles: special circumstances and respective capabilities of states; and non-discrimination between aircraft operators.

From 1 January 2012, the EU included aviation emissions in its ETS. Airlines were told to buy permits for 15 per cent of their carbon emissions, with the remainder provided to them as free allowances. It exempted airlines from countries with 'equivalent measures' to combat climate change. This violated the UNFCCC principle of common but differentiated responsibilities (CBDR), while not offering objective criteria to determine equivalence (Rajamani 2011).

There was strong pushback from developed and developing countries. In October 2011, India submitted several proposals to the UNFCCC, arguing that unilateral trade measures would violate the principle of CBDR and that poor countries would be paying rich ones, rather than the other way round (Government of India 2011). This was itself a point of contention. In one interpretation, exemptions for developing countries would not necessarily extend to exemptions for sub-national entities (airlines or passengers in this case) (Müller 2012). Other scholars, however, argued that while the EU had valid competitiveness concerns, it was still possible to introduce differentiation while avoiding 'crude differentiation' between developed and developing countries as blocs (Scott and Rajamani 2012: 481).

In February 2012, more than 20 countries, including China, India, Russia, and the US, debated a basket of countermeasures against the EU. Aviation officials urged the EU to let ICAO develop a global scheme. By March, China and India told their airlines not to comply with the directive; China halted orders worth US\$14 billion of Airbus aircraft; and the US threatened legal action. The EU agreed to temporarily suspend these requirements for international flights, but insisted that an ICAO deal 'cannot take 100 years ...' (International Centre for Trade and Sustainable Development [ICTSD] 2012).

In September 2013, the ICAO Assembly decided to develop a global market-based measures (GMBM) scheme to offset aviation

emissions. The plan was to adopt it in 2016 and bring it into force by 2020 (ICAO 2016b). In December 2015, ICAO's president tabled a draft policy on GMBM. In February 2016, ICAO's Committee on Aviation Environmental Protection achieved consensus on global aircraft standards for CO₂ emissions (ICAO 2016a).

The EU was again threatening to introduce unilateral measures. Its posture, described as 'contingent unilateralism', sought to create incentives for a global deal, in reaction to slow progress at multilateral forums (Scott and Rajamani 2013). However, a legal analysis of the EU's proposed scheme concluded that it could be challenged as a prohibited quantitative trade restriction (Bartels 2012).

Changes on the Ground

Opposition in the negotiations in both arenas notwithstanding, economic interests were beginning to shift within India. Uncertainties remained on the costs of transition, access to technology, and proportionate burden sharing, but market conditions within and outside the country were also changing.

Market Shifts and Technological Alternatives in the HFC Market

Segments of the Chinese and Indian chemical industry had opposed the HFC phase down. As major producers of the HCFC-22 refrigerant, 5 Indian companies, along with 19 other (mostly Chinese) firms, could destroy the by-product HFC-23 and earn credits under the Kyoto Protocol's Clean Development Mechanism (CDM). In 2010, two European non-governmental organizations (NGOs)—CDM Watch and the Environmental Investigation Agency—charged these firms with making supernormal profits, thanks to a perverse incentive to produce and incinerate even more HFC-23 (Schapiro 2010). The EU eventually banned HFC-23 carbon credits in the ETS as of May 2013.

Meanwhile, business opportunities emerged in other segments as Indian firms started undertaking research and development (R&D) for alternatives. By 2012, three companies in India were developing room air conditioners with refrigerants other than HFC-410a (which, with a global warming potential [GWP] of 2088, is a potent

GHG). These included: Godrej and Boyce, which was selling split air-conditioning systems with low-GWP HC-290 (propane; GWP < 5) with the highest five-star energy-efficiency rating; and Daikin and Panasonic with medium-GWP HFC-32 (GWP = 675). Daikin was willing to let developing country firms use basic HFC-32 patents at no charge through ‘non-assertion contracts’ (Council on Energy, Environment and Water [CEEW] et al. 2013).

Alternatives for automobile air conditioning were fewer and expensive. At the time, almost all mobile air conditioners produced or marketed in India used HFC-134a (GWP = 1430). Indian manufacturers could consider three options: HFO-1234yf (GWP = 4), which was significantly more expensive; HFC-152a (GWP = 124), which was less expensive but vehicles needed a secondary cooling loop to isolate the flammable refrigerant; and CO₂, which was cheap, although component costs to use it were significantly higher.

Manufacturers faced the dilemma between shifting production lines entirely to low-GWP refrigerants or building cars on two platforms, one for Indian consumers and one for exports. Nearly all vehicle manufacturers in China, Europe, India, Japan, and North America had chosen HFO-1234yf as the next-generation refrigerant (European and North American automakers had already introduced hydrofluoroolefin [HFO]-using models). There was an opportunity to leapfrog to low-GWP gases but the costs remained unclear.

India’s Aviation Sector Takes Off

International airline operators had historically won the lion’s share (approximately 60–90 per cent in key sectors) of India’s international aviation market. However, thanks to rapid growth in Indian aviation, the share of Indian operators in international passenger traffic increased from approximately 29 per cent to 38 per cent during 2004–16 (their share in freight traffic consistently stayed below 20 per cent) (Aggarwal et al. 2016: 6; Directorate General for Civil Aviation n.d.).

Would the GMBM adversely impact Indian operators? In the short run, the bulk of the impact would be on foreign operators. However, growth for the Indian operators would also be affected as their market shares rose. Moreover, there was a concern that some

foreign operators might undercut their competition by not passing costs of emission offsets on to the passengers. Many West Asian carriers, receiving significant government subsidies, could potentially offer discounted prices, whereas private Indian carriers would lose market share or profits if they had to absorb the costs of offsets (Jansen 2015; Open and Fair Skies 2015).

Contestations Redux: The Role of In-Country Analysis and Consultations

Changing market conditions and the emergence of new negotiating platforms had made it harder for India to reject discussions on HFCs and aviation outright. New analysis and consultations were needed.

Consultations with industry and other stakeholders were integral to evolving a negotiating posture. Research institutions such as the Centre for Science and Environment (CSE), CEEW, the Institute for Governance and Sustainable Development (IGSD), and the Natural Resources Defense Council (NRDC) organized several consultations. They also partnered with the Indian government or participated in consultations that the Ministry of Environment, Forest and Climate Change convened. Consultations included individual companies (Honeywell, Daikin, Panasonic, Godrej, Tata Motors, or Maruti Suzuki) and industry associations (Confederation of Indian Industry, Refrigeration Air Conditioning Manufacturers' Association, and Society of Indian Automobile Manufacturers).

Estimating HFC Emissions and Costs of Transitions

The consultations laid bare five issues of key concern to India (Ghosh 2013): (i) ensuring that CO₂ mitigation continued even if HFCs were phased down; (ii) identifying temperature impacts on India if HFCs, CO₂, or both, were not curtailed; (iii) understanding costs of transition, efficiency gains/losses, changing standards in export markets, commercial opportunities, and patent-related concerns; (iv) testing for safety and establishing standards for alternative refrigerants; and (v) seeking compensation for firms for lost business or help with new skills and technologies.

In 2015, Indian researchers analysed 16 industrial sub-sectors and estimated that, with no phase down, HFC emissions would increase to 500 metric tonnes of carbon dioxide equivalent ($\text{MtCO}_2\text{-eq}$) in 2050 (cumulatively, 6.55 gigatonne [Gt] $\text{CO}_2\text{-eq}$). About 63 per cent of HFC emissions in 2050 would be dominated by residential and commercial cooling sectors (Chaturvedi et al. 2015). Low-GWP refrigerants, energy-efficient products, and smaller floorspace could reduce residential air-conditioning emissions up to 46 per cent during 2010–50 (Chaturvedi and Sharma 2016). In commercial buildings, emissions could jump from 1.8 $\text{MtCO}_2\text{-e}$ in 2015 to 211 $\text{MtCO}_2\text{-e}$ in 2050 (Sharma, Chaturvedi, and Purohit 2017).

Costs of transition included that of alternative refrigerants, training servicing personnel, product design, and servicing equipment. In 2016, another study estimated economy-wide costs for India to be €12 billion (2015 prices) if India froze HFCs after 2030 (Purohit et al. 2016). This would rise to €34 billion with an earlier freeze date.

Once the analyses became public, India sought extra time to make a commitment. In bilateral consultations, American negotiators pushed back against using economy-wide costs as the basis of negotiations. The US-based NGOs also focused on funding under the MLF. A group of philanthropic foundations created a US\$53 million initiative for energy efficiency to complement the shift to HFC alternatives. However, Indian negotiators insisted that the full costs of transition had to be accounted for, and rejected other methodologies.

Another concern was access to technology. Environmental NGOs demanded a shift to natural refrigerants (CO_2 , ammonia, hydrocarbons, water, or air), which would avoid locking in manufacturers and consuming industries into new chemical refrigerants (Environmental Investigation Agency 2016). Substitute gases did not have manufacturing facilities in India (only Naveen Fluorochemical had started manufacturing HFO-1234yf under contract for Honeywell). Industry representatives repeatedly demanded access to patent-free alternatives. Although patents had historically not been a barrier to replacing ozone-depleting substances under the Montreal Protocol, concerns were rising regarding HFC alternatives: increased use of process, equipment, and application patents to extend intellectual property protection and create a

near monopoly for HFO blends (Bhushan 2016); whether the MLF would fully compensate for licensing costs; and need for greater R&D investment at home (Chaturvedi et al. 2016). Some Indian firms were developing alternatives, but industry as a whole was not ready. An overarching objective was to avoid periodic shifts from one refrigerant to another and, instead, find alternatives that would help Indian industry leapfrog over HFCs and avoid the 'chemical treadmill' altogether (Bhushan 2015).

Analysing and Projecting Aviation Growth and Emissions

The proposed GMBM for aviation emissions also embodied many uncertainties. First, the main proxy for calculating emissions was revenue tonne kilometres (RTKs), or the weight of revenue passengers and freight multiplied by kilometres flown. However, even with the same RTKs, fuel-efficient aircraft would emit less than less-efficient ones. For India, with relatively modern fleets, RTKs would either overestimate emissions or not give due credit for aircraft efficiency.

The second uncertainty was the impact on India's National Civil Aviation Policy, which targeted 200 million passengers and 10 million tonnes of freight by 2027, implying annual growth rates of 14 per cent and 20 per cent, respectively. By making air travel more expensive, the GMBM would make it harder to meet targets and erode market share for Indian operators.

A third issue was how to maintain differentiation and leave room for growth. In late summer 2016, although there had been almost no consultations with Indian airline operators, the government urgently sought new analysis to develop its negotiating position. Based on aviation trends in nearly 140 countries, a new study proposed four factors to evaluate options: inbound tourism/arrivals; outbound tourism/departures; per capita income; and presence of an aviation hub (Aggarwal et al. 2016: 7–8).

With growing incomes, demand for international air travel would rise. For middle-income countries, the ratio of outbound departures to population was 5–8 per cent; and for India, it was only 1.2 per cent. As Indians grew richer, outbound departures could rise to 40 million and inbound tourism up to 20 million annually. Even

without hosting a major international aviation hub, India would witness significant growth in international aviation.

Consequently, India's RTKs were estimated to rise from 6.5 billion to 19.3 billion when it reached middle-income status (around 2030), but only to 10 billion in 2020. If the GMBM capped RTKs in 2020, then by 2030 India would have to be offsetting 10 billion RTKs annually. As proposed, the GMBM would put significant burden on Indian aviation and undermine the principles of differentiation and respective capabilities under the Chicago Convention.

Getting the Deals

From a position of significant uncertainty, by 2015 and 2016, Indian negotiators had much more analysis on which to depend. The Paris climate deal also added momentum for deals on HFCs and aviation.

Kigali Amendment Balances Demands on HFCs

Soon after the in-country HFC emissions scenarios were published in 2015, India submitted a proposal to amend the Montreal Protocol: freezing HFC emissions in 2030–1 and reducing them to 15 per cent of peak value by 2050. Overall, 4.2 GtCO₂-eq could be avoided between 2010 and 2050 (41 GtCO₂-eq during 2050–2100). The shift occurred, thanks to in-country analysis, recognition of changing markets, and technology development within Indian industry. As a good faith measure, during the Kigali negotiations, India unilaterally promised to cease production of HFC-23 (Sarkar 2016).

Earlier proposals from North America, Europe, and small island states had demanded a 2021 freeze date for all countries. Eventually, developed countries agreed to an earlier baseline (2011–13) and freeze year (2019). For most developing countries (including China), the baseline was set at 2020–2, with 2024 as the freeze year. India and a few others secured a later baseline (2024–6), with freezing in 2028. By not satisfying everyone's demands, the Kigali Amendment signalled a good compromise.

Why did India change its stance? In November 2014, China and the US 'agreed to work together towards the global phase down of HFCs'

(The White House 2014). It became clear that India would have to craft its own strategy and not hitch its fortunes to China's. It, therefore, compromised and agreed to negotiate HFCs under the Montreal Protocol (Ghosh 2014). In June 2016, India and the US issued another joint statement 'to adopt an HFC amendment in 2016 with increased financial support from donor countries to the Multilateral Fund ... [and] to work together ... to address [GHG] emissions from international aviation' (Ministry of External Affairs 2016).

The final push in the late summer of 2016 was to introduce a wedge between India's and China's projected emissions. They are the only developing countries that manufacture HFCs but China's output is much bigger. In 2050, India's unabated HFC emissions would have been 7 per cent of the total against China's 31 per cent. India's air-conditioning market and HFC consumption were expected to accelerate only after 2025. Differentiation with China, which would witness rapid emissions during 2015–30, was warranted (Chaturvedi and Sharma 2015). India held this line on differentiation with China in Kigali—notably, a very different form of differentiation than that between North and South that has dominated the UNFCCC negotiations.

Overall, India demonstrated willingness to be part of a multilateral deal but secured a differentiated outcome. First, its heating, ventilation, and air-conditioning (HVAC) sector could grow, while refrigerant manufacturers got time to shift to alternatives. Second, the MLF would cover incremental costs related to production, consumption, servicing, and patents. Third, a review of technological options was envisaged so that India could test alternatives. In September 2016, it announced a domestic, collaborative R&D programme to develop next-generation, sustainable refrigerants (Bhasin, Sridhar, and Chaturvedi 2017). Fourth, despite three baselines, the bulk of global HFC emissions would be phased down earlier. Fifth, the deal was legally binding.

Differentiation Undermined in the ICAO Deal

In aviation, there remained considerable points of difference leading up to the 2016 ICAO Assembly. Both Brazil and China demanded autonomy to set criteria on eligibility of emissions units (ICAO

2016e, 2016f). China also proposed a voluntary first phase for the GMBM (2020–5). The EU insisted that voluntary steps would render it ineffective and wanted a ratcheting mechanism to increase ambitions based on periodic reviews (ICAO 2016c). The US suggested an opt-out mechanism, giving states flexibility to decide when to participate.

India's interests were more aligned with Brazil and China. They also converged, to an extent, with proposals from small island nations, which argued that tourism was an important component of their economies (ICAO 2016g). Several NGOs—the International Coalition for Sustainable Aviation (ICSA)—protested that the GMBM's exemptions weakened its environmental integrity. The ICSA wanted more focus on alternative fuels and quantifying life-cycle emissions for CO₂ standards (ICAO 2016d). These positions were consistent with India's demand for greater balance between offsets and other approaches.

The final GMBM deal came at the cost of both ambition and differentiation. It did not focus on actual emissions, giving manufacturers no incentive to develop more efficient aircraft. It prioritized offsets and shifted the burden to consumers. The GMBM becomes mandatory for all countries (barring small island states and least developed countries) only in 2027. Unlike the Kigali Amendment, there was no differentiation between developed and emerging economies, or among developing countries.

Estimated costs for offsetting vary from US\$2.66 to US\$18.82 per tonne of CO₂ (Chawla and Aggarwal 2016), but the deal does not distribute costs proportionately or based on historical responsibility. The shift from a 'sectoral' approach to 'individual offsetting' from 2030 discriminates against India. The draft ICAO proposal used the former whereby a single average growth factor for emissions would apply to all operators. The US, instead, wanted the individual approach, wherein operators with higher growth rates in RTKs would have to offset more. This approach absolved airline operators in developed countries from historical responsibility and laid disproportionate burden on airlines in fast-growing developing countries.

Climate governance is characterized by regime complexity. Although UNFCCC serves as the umbrella convention, issue-specific governance has emerged in several areas and via other institutions/initiatives, including HFCs (Montreal Protocol), aviation (ICAO), marine bunker fuels (International Maritime Organization), energy R&D cooperation (Mission Innovation), and solar energy promotion (International Solar Alliance). The HFC and aviation negotiations should be viewed in that context.

For several years, India resisted unilateral measures as well as international regulation outside the UNFCCC framework. Evolving market conditions, growing political pressure from bilateral deals, and the momentum created by the Paris Agreement changed the context and calculus for Indian negotiators. While the Paris Agreement relied on a bottom-up architecture, permitting each signatory to define its low-carbon pathway, the HFC and aviation deals were, ultimately, top-down.

The real shift within India was its attempt to make sense of complex technical issues on its own terms. Indian industry and negotiators recognized shifts in global markets. Research, analytics, and extensive consultations helped to move the needle. By showcasing economy-wide costs, India held the line for a later date for its own HFC phase down. In aviation, late-stage analysis and consultations helped India somewhat, but it failed on differentiation. The international deals created the condition for a common framework and avoided the risk of unilateral actions. However, in the future, domestic regulation, investment in technology, training of technical/servicing personnel, and nudging consumer behaviour will become central to achieving the aims of emission reduction while maintaining growth in an emerging economy.

References

- Aggarwal, Manu, Karthik Ganesan, Kanika Chawla, and Shikha Bhasin. 2016. Can India's Development Flight Take Off? What the ICAO Global Market Based Scheme Means for India. *CEEW Policy Brief* (August). New Delhi: Council on Energy, Environment and Water.
- Bartels, Lorand. 2012. 'The Inclusion of Aviation in the EU ETS: WTO Law Considerations', Issue Paper No. 6, International Centre for Trade and Sustainable Development.

- Bhasin, Shikha, Lekha Sridhar, and Vaibhav Chaturvedi. 2017. 'Developing an Ecosystem to Phase Out HFCs in India: Establishing a Research and Development Platform'. *CEEW Report* (October). New Delhi: Council on Energy, Environment and Water. Available at <https://www.ceew.in/publications/developing-ecosystem-phase-out-hfcs-india>; accessed on 11 June 2019.
- Bhattacharyya, Souvik. 2010. 'Natural Refrigerants: The Indian Perspective', 28 September. Available at http://www.atmo.org/presentations/files/38_SouvikBhattacharyya_IIT_NatRef-India.pdf; accessed on 23 September 2018.
- Bhushan, Chandra. 2015. *Getting the World off the Chemical Treadmill: A Per Capita Convergence Framework for an Ambitious Phase-Down of HFCs under the Montreal Protocol*. New Delhi: Centre for Science and Environment.
- . 2016. 'Resolving the IPR Issue During HFC Phase-Down: A Case Study of HFO1234yf in the Mobile Air-Conditioning Sector'. *Policy Brief*. New Delhi: Centre for Science and Environment.
- Chaturvedi, Vaibhav and Mohit Sharma. 2015. 'China's Role in Global HFC Emissions Matters for Phase-Down Proposals'. *CEEW Policy Brief* (August). New Delhi: Council on Energy, Environment and Water. Available at <https://www.ceew.in/publications/china%E2%80%99s-role-global-hfc-emissions-matters-phase-down-proposals>; accessed on 11 June 2019.
- . 2016. 'Modelling Long-Term HFC Emissions from India's Residential Air-Conditioning Sector: Exploring Implications of Alternative Refrigerants, Best Practices, and a Sustainable Lifestyle within an Integrated Assessment Modelling Framework', *Climate Policy*, 16(7): 877–93.
- Chaturvedi, Vaibhav, Mohit Sharma, Shourjomoy Chattopadhyay, and Pallav Purohit. 2015. 'India's Long Term Hydrofluorocarbon Emissions: A Detailed Cross Sectoral Analysis within an Integrated Assessment Modeling Framework. CEEW–International Institute for Applied Systems Analysis (IIASA) Report (May)'. New Delhi: Council on Energy, Environment and Water.
- Chaturvedi, Vaibhav, Bhaskar Deol, Steve Seidel, Anjali Jaiswal, Ankita Sah, Mohit Sharma, Nehmat Kaur, and Stephen O. Andersen. 2016. 'Cooling India with Less Warming: Examining Patents for Alternatives to Hydrofluorocarbons', Issue Paper (October), Council on Energy, Environment and Water, Natural Resources Defense Council, Center for Climate Energy Solutions, and Institute for Governance and Sustainable Development.

- Chawla, Kanika and Manu Aggarwal. 2016. 'A New Flight on Civil Aviation Emissions', *Livemint*, 19 October. Available at <http://www.livemint.com/Opinion/4KyXnoR5CoO5T4a17aitVP/A-new-flight-on-civil-aviation-emissions.html>; accessed on 23 September 2018.
- Council on Energy, Environment and Water (CEEW), Institute for Governance and Sustainable Development (IGSD), Natural Resources Defense Council (NRDC), and The Energy and Resources Institute (TERI). 2013. *Cooling India with Less Warming: The Business Case for Phasing Down HFCs in Room and Vehicle Air Conditioners*. New York, NY: NRDC. Available at <https://www.nrdc.org/sites/default/files/air-conditioner-efficiency-IP.pdf>; accessed on 23 September 2018.
- Directorate General for Civil Aviation. n.d. 'Monthly Statistics, Yearly Statistics, International Traffic Data'. Available at <http://dgca.nic.in/reports/stat-ind.htm>, accessed 11 September 2018.
- Earth Negotiations Bulletin*. 2009. 'Summary of the 21st Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, 4–8 November 2009', 19(73). Available at <http://enb.iisd.org/vol19/enb1973e.html>; accessed on 23 September 2018.
- Environmental Investigation Agency. 2016. 'Transitioning HFCs in India: The Opportunity for Climate Friendly Cooling in the Fast Food Industry', 15 September. Available at <https://eia-global.org/reports/transitioning-hfcs-in-india-the-opportunity-for-climate-friendly-cooling-in>; accessed on 23 September 2018.
- G8 Declaration. 2009. 'Responsible Leadership for a Sustainable Future', L'Aquila, Italy, 8 July.
- Ghosh, Arunabha. 2013. 'More Lethal Greenhouse Gas', *The Times of India*, 25 October. Available at <https://timesofindia.indiatimes.com/edit-page/More-lethal-greenhouse-gas/articleshow/24675848.cms>; accessed on 23 September 2018.
- . 2014. 'Breaking Through the Climate Chakravyuh', *Business Standard*, 25 November. Available at http://www.business-standard.com/article/opinion/arunabha-ghosh-breaking-through-the-climate-chakravyuh-114112401171_1.html; accessed on 23 September 2018.
- Government of India. 2011. 'Proposals for Inclusion of Additional Agenda Items in the Provisional of the Seventeenth Session of the Conference of the Parties, FCCC/CP/2011/INF.2/Add.1', 7 October. Available at <https://unfccc.int/documents/6897>; accessed on 23 September 2018.
- International Centre for Trade and Sustainable Development (ICTSD). 2012. 'India Confirms Boycott of EU Aviation Emissions Rule', *Bridges Weekly Trade News Digest*, 16(12). Available at <http://ictsd.org/i/news/bridgesweekly/129978/>; accessed on 23 September 2018.

- International Civil Aviation Organization (ICAO). 2016a. 'New ICAO Aircraft CO₂ Standard One Step Closer to Final Adoption', 8 February. Available at <http://www.icao.int/Newsroom/Pages/New-ICAO-Aircraft-CO2-Standard-One-Step-Closer-To-Final-Adoption.aspx>; accessed on 23 September 2018.
- . 2016b. 'Draft Assembly Resolution Text on a Global Market-Based Measure (GMBM) Scheme', 11 March. Available at <https://www.icao.int/Meetings/GLADs-2016/Documents/Draft%20Assembly%20Resolution%20text%20on%20GMBM%20for%202016%20GLADs.pdf>; accessed on 23 September 2018.
- . 2016c. 'European Perspective on a Global MBM Scheme for International Aviation', High-level Meeting on a Global Market-Based Measure Scheme, HLM-GMBM-WP/5, 26 April. Available at http://www.icao.int/Meetings/HLM-MBM/Documents/HLM_GMBM_WP5_EU.pdf; accessed on 23 September 2018.
- . 2016d. 'Views of the International Coalition for Sustainable Aviation (ICSA) on a Global Market-Based Measure for International Civil Aviation', High-Level Meeting on a Global Market-based Measure Scheme, HLM-GMBM-WP/6, 26 April. Available at <http://www.icao.int/Meetings/HLM-MBM/Documents/HLM-GMBM.WP6-ICSA.pdf>; accessed on 23 September 2018.
- . 2016e. 'China's Perspective on a Global MBM Scheme', High-Level Meeting on a Global Market-Based Measure Scheme, HLM-GMBM-WP/10, 5 May. Available at http://www.icao.int/Meetings/HLM-MBM/Documents/HLM_GMBM_WP10_China_EN.pdf; accessed on 23 September 2018.
- . 2016f. 'Alternative Proposal to Draft Assembly Resolution Text on a Global MBM Scheme for International Aviation: A Brazilian Contribution', High-Level Meeting on a Global Market-Based Measure Scheme, HLM-GMBM-WP/13, 9 May. Available at http://www.icao.int/Meetings/HLM-MBM/Documents/HLM_GMBM_Brazil_WP13_en.pdf; accessed on 23 September 2018.
- . 2016g. 'Alternative Proposal on Metrics for Phasing-in of States for the Global Market-Based Measure Scheme: Presented by Cook Islands, Fiji, Guyana, Jordan, Kiribati, Marshall Islands, Micronesia (Federal States of), Nauru, Palau, Papua New Guinea, Samoa, Seychelles, Singapore, Solomon Islands, Suriname, Tonga, Trinidad and Tobago, and Vanuatu', High-Level Meeting on a Global Market-based Measure Scheme, HLM-GMBM-WP/8, 13 May. Available at http://www.icao.int/Meetings/HLM-MBM/Documents/HLM_GMBM_WP8_Singapore_REV5.pdf; accessed on 23 September 2018.

- Jansen, Bart. 2015. 'Delta Dumps Dubai, Blames "Subsidized Capacity" from Gulf Rivals', *USA Today*, 29 October. Available at <http://www.usa-today.com/story/travel/flights/todayinthesky/2015/10/29/deltadumps-dubai-blames-subsidized-capacity-gulf-rivals/74794584/>; accessed on 23 September 2018.
- Lee, David S., David W. Fahey, Piers M. Forster, Peter J. Newton, Ron C.N. Wit, Ling L. Lim, Bethan Owen, and Robert Sausen. 2009. 'Aviation and Global Climate Change in the 21st Century', *Atmospheric Environment*, 43(22–3): 3520–37.
- Ministry of External Affairs. 2016. 'India–US Joint Statement during the Visit of Prime Minister to USA (The United States and India: Enduring Global Partners in the 21st Century)', 7 June. Available at [http://www.mea.gov.in/bilateral-documents.htm?dtl/26879/IndiaUS+Joint+Stat+ement+during+the+visit+of+Prime+Minister+to+USA+The+United+States+and+India+Enduring+Global+Partners+in+the+21st+Century](http://www.mea.gov.in/bilateral-documents.htm?dtl/26879/IndiaUS+Joint+Statement+during+the+visit+of+Prime+Minister+to+USA+The+United+States+and+India+Enduring+Global+Partners+in+the+21st+Century); accessed on 23 September 2018.
- Montreal Protocol. 2011. 'Bali Declaration on Transitioning to Low Global Warming Potential Alternatives to Ozone Depleting Substances', 25 November. Available at <http://conf.montreal-protocol.org/meeting/bureau/23mop-9cop/crp/English/BALI%20DECLARATION-E.pdf>; accessed on 23 September 2018.
- Müller, Benito. 2012. 'From Confrontation to Collaboration? CBDR and the EU ETS Aviation Dispute with Developing Countries', *Oxford Energy and Environment Brief* (February). Available at <https://www.oxfordenergy.org/publications/from-confrontation-to-collaboration-cbdr-and-the-eu-ets-aviation-dispute-with-developing-countries/?v=c86ee0d9d7ed>; accessed on 23 September 2018.
- Open and Fair Skies. 2015. 'Air France KLM Filing Urges Immediate Action by U.S. Government in Response to Gulf Carrier Subsidization', 18 June. Available at <http://www.openandfairskies.com/press-releases/in-case-you-missed-it-air-france-klm-filing-urges-immediate-action-by-u-s-government-in-response-to-gulf-carrier-subsidization/>; accessed on 23 September 2018.
- Padalkar, Atul. 2012. 'Status of Natural Refrigerants in the Indian Market'. Available at http://www.eurammon.com/sites/default/files/attachments/chillventa_2012_atul_sitaram_padalkar_the_situation_of_natural_refrigerants_in_india_fin.Pdf; accessed on 23 September 2018.
- Purohit, Pallav, Lena Höglund-Isaksson, Imrich Bertok, Vaibhav Chaturvedi, and Mohit Sharma. 2016. 'Scenario Analysis for HFC Emissions in India: Mitigation Potential and Costs'. *CEEW and IIASA Report* (September). New Delhi and Laxenburg: Council on Energy, Environment and Water and International Institute for Applied Systems Analysis.

- Rajamani, Lavanya. 2011. 'European Union, Climate Action Hero?', *The Indian Express*, 3 August. Available at <http://indianexpress.com/article/opinion/columns/european-union-climate-action-hero/>; accessed on 23 September 2018.
- Sarkar, Soumya. 2016. 'India Vows to Kill Super-Greenhouse Gas', *The Wire*, 15 October. Available at <https://thewire.in/73244/hfc-23-montreal-protocol-global-warming/>; accessed on 23 September 2018.
- Schapiro, Mark. 2010. "'Perverse" Carbon Payments Send Flood of Money to China', *Yale Environment* 360, 13 December. Available at http://e360.yale.edu/features/perverse_co2_payments_send_flood_of_money_to_china; accessed on 23 September 2018.
- Scott, Joanne and Lavanya Rajamani. 2012. 'EU Climate Change Unilateralism', *European Journal of International Law*, 23(2): 469–94.
- . 2013. 'Contingent Unilateralism: International Aviation in the European Emissions Trading Scheme', in Bart Van Vooren, Steven Blockmans, and Jan Wouters (eds), *The EU's Role in Global Governance: The Legal Dimension*, pp. 209–23. Oxford: Oxford University Press.
- Sharma, Mohit, Vaibhav Chaturvedi, and Pallav Purohit. 2017. 'Long-Term Carbon Dioxide and Hydrofluorocarbon Emissions from Commercial Space Cooling and Refrigeration in India: A Detailed Analysis within an Integrated Assessment Modelling Framework', *Climatic Change*, 143(3–4): 503–17.
- Sridhar, Lekha and Vaibhav Chaturvedi. 2017. Can India's Air Conditioning Service Sector Turn Climate Friendly?: Evaluating the Skill Gap. *CEEW Report* (October). Available at <https://www.ceew.in/publications/can-india-air-conditioning-service-sector-turn-climate-friendly>; accessed on 11 June 2019.
- The White House. 2013. 'United States and China Agree to Work Together on Phase Down of HFCs', 8 June. Available at <https://obamawhitehouse.archives.gov/the-press-office/2013/06/08/united-states-and-china-agree-work-together-phase-down-hfcs>; accessed on 23 September 2018.
- . 2014. 'U.S.–China Joint Announcement on Climate Change', 12 November. Available at <https://obamawhitehouse.archives.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change>; accessed on 23 September 2018.
- United Nations Framework Convention on Climate Change (UNFCCC). 2014. 'National Greenhouse Gas Inventory Data for the Period 1990–2012: Note by the Secretariat', Subsidiary Body for Implementation, Forty-First Session, Lima, 1–8 December 2014. Available at <http://unfccc.int/resource/docs/2014/sbi/eng/20.pdf>; accessed on 23 September 2018.

- Velders, Guus J.M., David W. Fahey, John S. Daniel, Stephen O. Andersen, and Mack McFarland. 2015. 'Future Atmospheric Abundances and Climate Forcings from Scenarios of Global and Regional Hydrofluorocarbon (HFC) Emissions', *Atmospheric Environment*, 123(A): 200–9.
- Velders, Guus J.M., David W. Fahey, John S. Daniel, Mack McFarland, and Stephen O. Andersen. 2009. 'The Large Contribution of Projected HFC Emissions to Future Climate Forcing', *Proceedings of the National Academy of Sciences*, 106(27): 10949–54.
- Xu, Y., D. Zaelke, G.J.M. Velders, and V. Ramanathan. 2013. 'The Role of HFCs in Mitigating 21st Century Climate Change', *Atmospheric Chemistry and Physics*, 13: 6083–9. Available at <http://www.igsd.org/wp-content/uploads/2014/10/acp-13-6083-2013.pdf>; accessed on 23 September 2018.

SECTION III

POLITICS

Climate Change, Civil Society, and Social Movement in India*

Pradip Swarnakar

Climate change is an unavoidable issue in India because a large number of Indians live in geographically vulnerable areas periodically affected by climate-related extreme weather events. In India, climate change-related activities are primarily managed by the government, but civil society organizations (CSOs)¹ are an integral part of policy formulation and implementation. India has a vibrant civil society working in various fields of environment and development, with a considerable emphasis on climate change-related issues. This

* I would like to thank Navroz Dubash, Stephen Zavestoski, Tuomas Ylä-Anttila, and Ambuj Sagar for their comments.

¹ Civil society is a loosely defined concept, often considered to be the third force of a society, the others being the state and economy (Cohen and Arato 1992: ix). For this chapter, the term CSO is used to mean a non-profit organization not formally bound by business or governmental interests but which might, nonetheless, engage with them in its advocacy work.

engagement varies from policy advocacy and scientific research to community-based adaptation and grassroots mobilization.

The CSOs in the Global North are engaged in nature conservation and preservation associated with wilderness movements. However, in India, environmental activism follows a different discourse called 'environmentalism of the poor' (Martinez-Alier 2014), wherein protest is an outcome of the livelihood crises faced by marginalized populations that are highly dependent on natural resources (like forests and water). These protests have emerged as a result of governmental development agendas linked to the creation of dams, deforestation, and mining activities (Guha and Martinez-Alier 1997). When the climate change debate was surfacing globally in the early 1990s, based on concerns about global warming and its negative impacts, like rising sea-levels and biodiversity loss, Indian environmentalists were 'ambiguous about engaging with climate change' activism (Lele 2012: 208). Like other developing countries, India was more concerned with the challenges of development than the threat of climate change (Lele 2012). In order to support the developmental agenda of the government, CSOs in India were more concerned with developmental challenges like education, health, and other rural and urban development issues. The issue of climate change created a puzzle in the discourse of environmentalism of the poor, but, according to some, 'climate change has brought environmentalism into the political mainstream' (Dubash 2009b: 63).

Thus, for CSOs working on environmental issues in India, climate change is an opportunity to extend their environmental activism. However, the method of activism may not necessarily follow the Northern discourse regarding global warming and biodiversity loss. Instead, environmentalism of the poor, or livelihood-related discourse, can create a useful framework to engage with climate change. Concerning climate activism in India, the CSOs can play two crucial roles: (i) they can play a part in community-based approaches to the government's adaptation and mitigation policies; and (ii) through championing these practices, they can demonstrate how economic development can be decoupled from the burning of fossil fuels. However, CSOs may undermine their legitimacy to the extent that these activities are seen as oppositional to the development and economic growth goals of the government and corporations.

Based on this background, the purpose of this chapter is to illustrate the activities of Indian CSOs that primarily focus on climate change. The chapter is divided into four sections. The first section elucidates what CSOs can gain from discursive possibilities and openings created by the global climate change debate. Focusing on the politics of CSOs' overall climate change-related activities, the next section elaborates two distinct frameworks by which CSOs' engagement can be understood: (i) the 'climate sustainability frame', wherein CSOs' activities are more focused on issues which generally avoid confrontation with the national government or corporations; and (ii) the 'climate justice frame', wherein CSOs focus on human rights, highlighting the vulnerabilities of marginal communities, in direct or indirect conflict with the government and corporations. The third section discusses how the climate justice framework can carry two different connotations based on its geographical scale of focus. When CSOs discuss historical emissions and international justice, they legitimize the policy position of the national government. However, when other CSOs discuss domestic injustice and vulnerabilities of the poor as a result of national policy and corporate atrocities, they delegitimize the national government. The fourth and final section discusses international collaboration by Indian CSOs either as members of international coalitions or in joint deliberations in international climate meetings.

Climate Change as a Christmas Tree: Discursive Possibilities and Openings

The Ministry of Environment and Forests (MoEF) was established in India in 1985 in line with the Indian constitutional scope, which states that 'the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country' (Divan and Rosencranz 2001: 45). Until 2007, climate change was mainly a foreign-policy issue collaboratively handled by the Ministry of External Affairs and the MoEF (Dubash and Joseph 2016: 46). Then, the establishment of the Prime Minister's Council on Climate Change (PMCCC) in 2007 widened the scope to include the media, businesses, and non-governmental organizations (NGOs) (Aamodt and Stensdal 2017: 117). For the environmental CSOs in India, 'local

environmental and developmental issues were the main concern for decades' (Aamodt and Stensdal 2017: 121). However, in the early twenty-first century, CSOs began to link their existing work with global climate change (Lele 2012). This process of engagement with climate change can be described through a 'Christmas tree' model, wherein everyone (including CSOs) hung their favourite baubles or their existing areas of focus in the global climate change debate (Hulme 2009). It has been observed that, 2007 onwards, CSO engagement with climate change issues began increasing substantially. This 'rapid increase in the number and diversity of organizations' focusing on climate change is known as the process of crowding-in (Ylä-Anttila and Swarnakar 2017: 279). The crowding-in of Indian CSOs evolved from five distinct mechanisms, mostly influenced by the activities of global institutions: the expansion of discursive opportunities; the effects of global conferences; the network effects created by expanding global CSO networks; the adoption and innovation of action repertoires; and global pressure effects that propel states to act in ways that create opportunities for CSOs (Ylä-Anttila and Swarnakar 2017: 274).

The first mechanism is the expansion of discursive opportunities, which demonstrates that climate change is already in the global discourse and Indian CSOs have achieved the opportunity to reframe their issues in line with this global debate. Second, international climate events, such as the annual United Nations climate conferences (Conference of the Parties [COP]) and other related events, attract a large number of CSOs from the Global South, particularly from India, to exhibit domestic and grassroots activities. Third, the personal and inter-organizational network of Indian CSOs creates the opportunity to mobilize funds and 'boost national-level mobilization on a global issue' related to climate change. Fourth, to promote climate change awareness, CSOs can follow traditional social movement repertoires, but they can also innovate new repertoires. Finally, the process of crowding-in follows the mechanism of global pressure effect, which creates political opportunities for CSOs at the state and local level, primarily through various global institutions (Ylä-Anttila and Swarnakar 2017: 281–7).

Scholars have argued that the creation of major policies related to climate change in India have been influenced by global climate

change negotiations (Dubash 2009a; Vihma 2011). From the discussion here, it may be concluded that Indian CSOs gained considerable opportunities 2007 onwards to increase engagement with climate change-related activities. However, the activities of CSOs do not always follow government mandates, and they sometimes even create conflict. The next section will discuss how the politics of climate change is inextricably intertwined with the science of climate change and how the activities of Indian CSOs are related.

Decoupling Politics from Science: Climate Sustainability and Climate Justice

At the macro level, climate change is caused by a disturbed carbon cycle, which means that more carbon is entering the atmosphere than it has a natural capacity to recycle. This problem can be solved either by using more efficient or innovative technologies or 'by changing the exploitative nature of development' (Roy 2015: 31). Most nation-states do not want to compromise their respective developmental agendas or the quality of life of their citizens. Therefore, they either look for technological fixes or dodge the problem by denying/questioning the science, or claiming the right to development. Moreover, in the last 50 years, the primacy of science in global warming politics has failed to produce meaningful results because the solutions have largely depended on the relationship between scientists, environmentalists, and politicians, which has changed over time (Howe 2016). Even if people wish to take action based on scientific knowledge, it is complicated to determine the economic feasibility of such action. Scholars have argued the (im)possibility of decoupling economic growth and negative ecological impact (Fletcher and Rammelt 2017).

To elaborate on the activities of Indian CSOs, the decoupling of the politics of climate change actions and climate science must be discussed.² In the last three decades, climate science has proven

² To summarize the climate policy position of India, Dubash (2009a) has outlined three archetypical political perspectives adopted by various climate actors, including CSOs: (i) growth-first realists have a rigid policy agenda on domestic action; (ii) sustainable development realists demand

(with objective facts and data) that global warming is occurring and if the process continues, then the existence of the earth and human beings will be jeopardized (Chapters 2 and 3 in this volume). The scientific knowledge, in other words, demands action concerning mitigation and adaptation by stakeholders. Possible actions include economic, technological, and policy support from national governments, intergovernmental agencies, and corporations. In this context, CSOs' actions are mainly directed towards compelling institutional leaders to act on the scientific knowledge in order to create a sustainable society, particularly for ordinary citizens. All participants in the climate debate have a political agenda or position because climate, like all environmental problems, is an inherently political issue.³ For example, if the government wants to pass a new law to reduce fossil fuels, then the government will be in opposition with the fossil fuel industry.

The nuanced relationship between government and industry pushes the CSOs⁴ to adopt one of two strategic frameworks. The first is the climate sustainability framework, which is primarily targeted at the betterment of the environment, breakthroughs in climate science, and innovations in climate-friendly technology. The CSOs that work in this strategic frame are apolitical because they avoid directly confronting other interest groups, such as the national government or corporations. There are two main reasons for choosing this framework. First, the organization might be focused on climate science research in line with international bodies like Intergovernmental Panel on Climate Change (IPCC). Second, the organization could be instrumental for setting the government's

both national and global equity with co-benefits; and (iii) sustainable development internationalists are driven by the idea of domestic action and linking it to the national and global policy process. Taking cue from Dubash, Isaksen and Stokke (2014: 114) exhibit three discourses in Indian climate politics: Third World, win-win, and radical green.

³ The term 'political' is being used in a non-pejorative way, in the sense of value loaded.

⁴ In India, the activities of CSOs can be classified mainly into five types of climate change activities: raising awareness, advocacy, research, mitigation, and adaptation (Oivo 2014).

agenda with regard to climate mitigation policy. The Energy and Resources Institute (TERI) is the oldest and most prominent organization in India (Chapter 7 in this volume) that often contributes to IPCC assessment reports and framing of mitigation policy (Dubash 2015).⁵ In recent years, a group of non-government think tanks have actively engaged with the government's climate policy, particularly sustainable energy transition models (Dubash 2015: 2). For example, the founder of Delhi-based Integrated Research and Action for Development is a former member of the Planning Commission and is involved in the policy process of low-carbon strategies and inclusive growth (Planning Commission 2014). Other CSOs, like the Council on Energy, Environment and Water (CEEW), Center for Study of Science, Technology & Policy (CSTEP), and Shakti Sustainable Energy Foundation (SSEF),⁶ have written post-Paris policy road maps directing future energy transition pathways (Chaturvedi, Koti, and Chordia 2018; Sridhar et al. 2018; SSEF 2018).

Alternatively, there is a group of CSOs whose activities are part of a climate justice framework.⁷ The CSOs working in this framework advocate for environmental justice and emphasize inclusive solutions to climate change because the people at the bottom of the pyramid are the first victims of climate disasters due to lack of resources and adaptability (Bullard and Johnson 2000). Moreover, CSOs in this category believe that while the government is focused on a technological fix, 'the poor are demonstrating the best practice for mitigating and adapting to climate change' (Roy 2015: 39). For these CSOs, vulnerability and adaption of the

⁵ For example, see the TERI (2016) report regarding nationally appropriate mitigation action strategies in India.

⁶ In 2014, SSEF provided technical support for a government briefing paper for United Nations Framework Convention on Climate Change (UNFCCC) COP 20. Available at http://envfor.nic.in/sites/default/files/press-releases/Indian_Country_Paper_Low_Res.pdf; accessed on 4 September 2018.

⁷ Here, justice refers to a moral or ethical obligation to share the burden of negative impacts of climate change. The idea of climate justice is discussed in more detail in the next section.

local community are key issues. For example, organizations like the Hazards Centre (Roy 2015), Delhi Science Forum (Raghunandan 2012), Environics Trust, and Indian Network on Ethics and Climate Change (Ray et al. 2011) are often critical to climate policy because they focus on human rights-based approaches to vulnerability and adaptation of marginalized communities. This strategic frame of action is very much political because it often targets a specific organization or institution which is responsible for contributing to climate change. This can be a multinational corporation, foreign government or even the national government, or a local industry. Furthermore, this framework actively addresses class differences between the rich and poor. In most cases, rich people or countries are responsible for creating climate problems, while the poor suffer the consequences.

Indian CSOs employing both climate sustainability and climate justice frameworks agree with climate science and believe that climate change is real and anthropogenic. This is because the public discourse in India, unlike in the United States (US), has generally accepted climate change as a scientific reality, and there is very little denial of global climate change (Billet 2010; Kukkonen et al. 2018). It is important to note that the two framing categories are not mutually exclusive. An organization can engage in activities from both frameworks. It is easy to identify whether a specific activity is based on the sustainability or justice framework. For example, the Centre for Science and Environment (CSE) is a major knowledge-based organization which has engaged in both climate science and policy as well as justice issues (Gough and Shackley 2001). The idea of climate justice is complicated and often debated. The political opportunity structure⁸ of CSOs varies depending on whether their focus is on the international or national domain. The next section will elaborate on two different types of climate justice claims.

⁸ Sidney Tarrow (1994: 76–7) defined political opportunity structures as the ‘consistent—but not necessarily formal or permanent—dimensions of the political environment that provide incentives for collective action by affecting people’s expectations for success or failure.’

Two Sides of Climate Justice: International versus Domestic

Climate politics represents struggles over the sharing and sustaining of valued goods, particularly natural and common property resources. Climate justice⁹ arguments focus on the unequal distribution of climate change effects which were caused, or are being caused, by a certain group of people: 'Asymmetries of cause and effect in climate change directly reflect global development divides, making the question of how to address climate change unalterably a question of justice' (Goodman 2009: 501). This discussion of justice is based on moral and normative claims of who is responsible for creating the problem and who is suffering or going to suffer most.¹⁰ Before discussing CSOs' climate justice activities, the policy position of the Indian government and its close relation with the concept of climate justice should be examined. In global climate negotiations, India has been a 'staunch advocate and defender of the Kyoto Protocol principle of common but differentiated responsibility (CBDR)' (Raghunandan 2012: 123; see also Kukkonen et al. 2018; Lele 2012), which emphasizes the ecological debt (Srinivasan et al. 2008) of the developed countries responsible for historical emissions. This position is based on the concept of international climate justice. The primary advantage of this position is that India, as a developing country, can easily escape any legally binding commitment.

This position is influenced by a report from the CSE (Lele 2012), which clearly differentiates between the survival emissions of the poor

⁹ The definition of climate justice is contested and covers a range of approaches, from a demand for historical responsibility to per-capita equity to developmental, human, and environmental rights-based arguments. Climate justice means 'moving to a post-carbon energy system, paying for the ecological and social damage of climate change, and protecting the voice and sovereignty of the most vulnerable' (Schlosberg and Collins 2014: 367).

¹⁰ In this context, Bond and Dorsey (2010: 293–4) identified five climate justice positions for elite or mainstream NGOs: the development rights approach; a related right or need to industrialize; a negotiated North/South approach; a human rights approach; and a commitment to carbon markets. They also mentioned that none of these five positions actually help to build a climate movement.

and the luxury emissions of the rich (Agarwal and Narain 2012).¹¹ In India's policy domain, this long-standing position is sacrosanct and, to a great extent, above critical assessment. For example, during the Copenhagen climate conference, Environment Minister Jairam Ramesh 'sought to position India as a forward-looking player in climate negotiations' by emphasizing domestic action (Dubash and Joseph 2016: 48). This 'narrative re-formulation' immediately resulted in strong opposition from various policy actors in India, including mainstream CSOs, who claimed that 'domestic climate policy in India should be minimally linked to the international process' (Dubash and Joseph 2016: 48). More recently, during the Paris climate conference,¹² India submitted its pledge in the form of the Intended Nationally Determined Contribution (INDC). The title of the report clearly highlights the term 'climate justice' (Government of India [GoI] 2015). For the GoI, the idea of climate justice is regarded as being owed an ecological debt. During the Marrakesh COP, Environment Minister Anil M. Dave said that 'climate justice for India was the same as receiving finance from developed countries' (Venkat 2016). From the aforementioned discussion, it may be concluded that if Indian CSOs advocate for international climate justice, then they are actually supporting or legitimizing the policy position of the state. In this situation, there is much less chance of conflict with the national bureaucratic apparatus, and it may even create opportunities for CSOs to receive funding from government departments.

On the other hand, another group of CSOs argue domestic injustice and vulnerabilities of the poor, attributing these to

¹¹ The CSE and TERI are two of the most influential CSOs to shape government policy (Isaksen and Stokke 2014: 113). The CSE, TERI, and MoEF were instrumental in creating a climate advocacy coalition with the core belief that 'India should concentrate on adaptation policies, and on mitigation policies that can provide co-benefits for basic developmental problems' (Aamodt and Stensdal 2017: 121; see also Dubash 2013).

¹² The success of the Paris Agreement was mainly based on the voluntary commitments of nation-states. It has been observed that during COP 21, 'despite the rise of neo-conservatism and self-interested power politics, questions of global distributive justice remain a central aspect of the international politics of climate change' (Okereke and Coventry 2016: 834).

insufficient national policies and corporate atrocities. The domestic climate justice framework is not appreciated by the government, and on many occasions it has been confronted with repressive measures by the state. Before the establishment of the PMCCC or the crowding-in of Indian CSOs, a noticeable climate justice movement occurred during the COP 8 Summit in New Delhi in 2002. The protest group was a coalition of fishermen from Kerala and West Bengal representing the National Fishworkers' Forum and farmers from the Andhra Pradesh Vyavasay Vrudhidarula Union (Agricultural Workers and Marginal Farmers Union). They were supported by activists including those from Narmada Bachao Andolan, indigenous peoples from the northeast, and groups from mining-impacted areas of Odisha (Khastagir 2002; Pettit 2004: 103; Roberts and Parks 2009: 385–6). The organizers of the movement called it the 'human face of the rising movement for Climate Justice' (Khastagir 2002).

Three important points should be noted in this context. First, CSOs working within the domestic climate justice framework do not accept market-based principles because they believe that a market-based capitalist ecosystem is primarily responsible for today's climate change. Second, they are closely associated with the concept of environmentalism of the poor and the struggles of marginalized people to maintain their traditional livelihoods. Such struggles are local and many associations are active in their local communities, and thus are connected with people's livelihoods (for example, farmer or fisherman's unions). Third, when activists raise issues about domestic-level justice (both environmental and climate, which are interconnected¹³), then they may face state repression. In the past, 'environmental activists have been beaten up, vilified and shot for campaigning against the building of dams and the relocation of multinational corporations on their home soil' (Rowell 1996: 1). During the anti-coal movement, Greenpeace India faced strong retaliation from the government (Talukdar 2018). Moreover, scholars have argued that state–NGO relationships can be characterized

¹³ The climate justice movement may be understood as 'an addition to, or extension of, environmental justice perspectives' (Kluttz and Walter 2018: 94).

by 'hostility of politicians, party workers, local élites, lower level bureaucrats, and lower level employees of the state toward NGO activity' (Sen 1999: 327).

The CSOs in India are often involved in climate justice (both international and domestic), but the very idea of climate justice has been adopted by the government and used as a long-standing strategy for international negotiation. This could help CSOs that focus on climate justice to avoid immediate conflict with the government. However, in some cases, particularly in local environmental struggles, the government and CSOs have come into conflict (Ylä-Anttila et al. 2015). The CSOs often engage in climate change and related environmental debates, but 'the multitude is not bracketed by unified antagonism' (Harms and Powalla 2014: 190). To overcome domestic hurdles, is it possible for local small-scale CSOs to receive support (moral and financial) from an international audience, mainly international environmental organizations? In this context, it is essential to understand the opportunities of those CSOs that have become members of international climate coalitions or presented their stories in annual COP meetings. The next section will elaborate on this issue.

The Power of Network and Collective Bargaining

In the Indian climate domain, representatives of NGOs are 'actively involved in network building initiatives, such as CANSA' (Azhoni, Holman, and Jude 2017: 152). The Climate Action Network South Asia (CANSA)¹⁴ was established in 1991 by a group of 'South Asian NGOs and scientists who were concerned about the adverse impact of global climate change on the poor and most vulnerable sections of the society' (Behera 2012: 17). In 2018, CANSA had 160 member organizations from 8 countries.¹⁵ Members of CANSA have the opportunity to work on national and sub-national issues. Being a member of this global platform, a CSO can connect with other like-minded CSOs in India or other South Asian countries.

¹⁴ The CANSA is the South Asian branch of the transnational NGO network, Climate Action Network (CAN) (see Duwe 2001).

¹⁵ See <http://www.cansouthasia.net>; accessed 23 May 2018.

This network works closely with the government and has become a significant bridge between the CSOs and the government. For example, before the Paris COP 21, CANSA acknowledged the need for India's rights to economic development and highlighted the government's effort towards renewable energy solutions. The CANSA report stated:

India's goals for economic growth are ambitious. ... There is progress from the Modi government on renewable energy (RE), and promises to build smart cities, model villages, to develop solar power and to deliver electricity for all. ... the dominant view of government is that growth is required before resources can be invested in climate action: *growth first, climate action later*. ... We make the convincing case that moving to sustainable energy now could deliver India's desired growth and development objectives. (CANSAs 2015: 2; emphasis added)

Another significant coalition in climate action is Climate Justice Now! (CJN!), a global network of CSOs campaigning for climate justice. The CJN! was founded at the 2007 UNFCCC meeting in Bali, and it strongly mobilized CSOs during UNFCCC meetings in Copenhagen and Cancun. In 2007, CJN! asserted four core climate action principles: (i) those who have benefited most from economic growth should be responsible for reducing greenhouse gas emissions and funding renewable energy; (ii) natural resources should be distributed fairly; (iii) there should be equal participation in decision making; and (iv) those who are suffering the worst effects of climate change should be compensated (Kluttz and Walter 2018: 95; Koukouzelis 2017). Climate Action Network (CAN) is a dominant member of the UNFCCC system, and some non-state actors were not happy with its overall approach. The CJN! emerged from 'a split from the remainder of the ENGO constituency where the mainstream Climate Action Network (CAN) allocated the constituency focal point' (Kuyper, Bäckstrand, and Schroeder 2017: 98). In 2014, CJN! included 730 member organizations, 29 of which were from India (CJN! 2014).¹⁶

¹⁶ The website is no longer active and the data were gathered from archives.

The overall objectives of these two important climate coalitions are different, and Indian CSOs can receive different membership benefits from them. If a CSO is working from a sustainability or international climate justice framework (supporter of growth first, CBDR policy), then membership with CANSA can lead to vital opportunities. Alternatively, if the CSO is more radical and has a conflict of interest with the state (supporter of domestic justice or anti-fossil fuel activity), then the CJN! network can be a compelling opportunity to mobilize moral and financial support. There is a clear distinction between these two groups: the 'first generation of the reform-oriented pragmatic climate movement, embodied in CAN, and the second generation anti-capitalist, system-critical radical climate justice movement of CJN!' (Kuyper, Bäckstrand, and Schroeder 2017: 98). Apart from being a member of a transnational civil society network, a CSO can also exhibit its activities by participating in international climate negotiations at COPs, particularly during smaller events.

It has been well documented that NGOs have been key players in the early development of the climate regime (Bäckstrand et al. 2017). From the beginning, 'civil society has been an important and defining feature' in all of the mega climate change meetings (COP) and until 2009, 'over half (51 percent) came from civil society, representing over 1,300 NGOs' (Cabr   2011: 10). During COP 21 in Paris, more than 2,000 observer organizations were accredited and admitted (Kuyper, B  ckstrand, and Schroeder 2017: 95). In order to assess the potential opportunities of the international network, Indian CSOs often participate in annual COP meetings. By analysing the participation network of Indian CSOs during smaller events, Swarnakar and Yl  -Anttila (2016) found that a few clusters of organizations, primarily disconnected from the larger influential organizations, regularly participate in exhibiting their views on grassroots problems. It has also been found that justice-based organizations, like the Centre for Community Economics and Development Consultants Society and Public Advocacy Initiatives for Rights and Values in India, have a core collaboration network with the organizations from India, South Asia, and developed countries. However, CSOs like TERI, that operate from both the climate sustainability framework and the international justice framework, are connected with the prominent research and funding organizations of developed nations.

Need for a Grand Narrative

This chapter broadens the understanding of complex, multi-layered relationships between climate change, civil society, and related social movements in India. India has a long history of environmental activism tied to livelihood concerns of marginalized communities, often labelled the ‘environmentalism of the poor. At the time of India’s prominent environmental justice movements like Narmada and Chipko, both of which focused on the impacts of state policies and actions on local livelihoods, climate justice was not part of the mainstream discourse. From 2007, however, a large number of CSOs moved beyond the framework of local livelihood issues to engage in climate-related issues. The Indian climate justice movement is descended from both the traditional environmentalism of the poor and the Indian climate change movement of CSOs crowding-in after 2007. However, neither arm of the Indian climate change movement has succeeded in giving birth to a collective narrative of climate justice. Looking at the history of engagement in climate change policy, it can be inferred that, in India, the idea of climate justice has been, to a large extent, adopted by the government and used as a mainstream policy agenda for international negotiations. However, it is difficult to integrate CSOs’ actions into a single narrative because Indian civil society is also somewhat conflicted, wanting to hold both the Indian government and the North accountable. Finally, Indian CSOs, particularly those with a more radical domestic justice focus, are confined to local issues and fail to create a grand narrative linked to global climate issues (like 2 degrees, 350 parts per million, and so on). The future success of Indian climate change activism depends on reclaiming the climate justice narrative from the government. Whether Indian CSOs will accomplish this through international networks or by building local power is yet to be seen.

References

- Aamodt, Solveig and Iselin Stensdal. 2017. ‘Seizing Policy Windows: Policy Influence of Climate Advocacy Coalitions in Brazil, China, and India, 2000–2015’, *Global Environmental Change*, 46(September): 114–25.
- Agarwal, Anil and Sunita Narain. 2012. ‘Global Warming in an Unequal World’, in Navroz K. Dubash (ed.), *Handbook of Climate Change and*

- India: Development, Politics and Governance*, p. 81. New Delhi: Oxford University Press.
- Azhoni, Adani, Ian Holman, and Simon Jude. 2017. 'Adapting Water Management to Climate Change: Institutional Involvement, Inter-institutional Networks and Barriers in India', *Global Environmental Change*, 44(September): 144–57.
- Bäckstrand, Karin, Jonathan W. Kuypers, Björn-Ola Linnér, and Eva Löwbrand. 2017. 'Non-state Actors in Global Climate Governance: From Copenhagen to Paris and Beyond', *Environmental Politics*, 26(4): 561–79.
- Behera, Navnita Chadha. 2012. 'SAARC and Beyond: Civil Society and Regional Integration in South Asia', in Sultan Hafeez Rahman, Sridhar Khatri, and Hans-Peter Brunner (eds), *Regional Integration and Economic Development in South Asia*, pp. 3–42. Cheltenham: Edward Elgar Publishing.
- Billett, Simon. 2010. 'Dividing Climate Change: Global Warming in the Indian Mass Media', *Climatic Change*, 99(1–2): 1–16.
- Bond, Patrick and Michael K. Dorsey. 2010. 'Anatomies of Environmental Knowledge & Resistance: Diverse Climate Justice Movements and Waning Eco-neoliberalism', *The Journal of Australian Political Economy*, 66: 286–316.
- Bullard, Robert D. and Glenn S. Johnson. 2000. 'Environmentalism and Public Policy: Environmental Justice: Grassroots Activism and Its Impact on Public Policy Decision Making', *Journal of Social Issues*, 56(3): 555–78.
- Cabré, Miquel Muñoz. 2011. 'Issue-Linkages to Climate Change Measured through NGO Participation in the UNFCCC', *Global Environmental Politics*, 11(3): 10–22.
- Chaturvedi, Vaibhav, Poonam Nagar Koti, and Anjali Ramakrishnan Chordia. 2018. *Sustainable Development, Uncertainties, and India's Climate Policy: Pathways towards Nationally Determined Contribution and Mid-Century Strategy*. New Delhi: Council on Energy, Environment and Water.
- Climate Action Network South Asia (CANSAs). 2015. 'India's Triple Challenge: Growth, Development and Climate Change', November. Available at http://www.cansouthasia.net/pdf_files/Triple_Challenge.pdf; accessed on 23 May 2018.
- Climate Justice Now! (CJN!). 2014. 'CJN! Network Members'. Available at <http://web.archive.org/web/20150405192316/http://www.climate-justice-now.org/category/climate-justice-movement/cjn-members>; accessed April 2015.

- Cohen, Jean L. and Andrew Arato. 1992. *Civil Society and Political Theory*. Cambridge: MIT Press.
- Divan, Shyam and Armin Rosencranz. 2001. *Environmental Law and Policy in India*. New Delhi: Oxford University Press.
- Dubash, Navroz K. 2009a. 'Toward a Progressive Indian and Global Climate Politics', CPR Climate Initiative Working Paper No. 1, Centre for Policy Research, New Delhi, 1 September.
- . 2009b. 'Environmentalism in the Age of Climate Change', *Seminar*, 601: 63–6.
- . 2013. 'The Politics of Climate Change in India: Narratives of Equity and Cobenefits', *Wiley Interdisciplinary Reviews: Climate Change*, 4(3): 191–201.
- . 2015. 'Critical Knowledge Gaps That Influence India's Role in Global and Domestic Climate Change Platforms'. New Delhi: Centre for Policy Research.
- Dubash, Navroz K. and Neha B. Joseph. 2016. 'Evolution of Institutions for Climate Policy in India', *Economic & Political Weekly*, 51(3): 45–54.
- Duwe, Matthias. 2001. 'The Climate Action Network: A Glance Behind the Curtains of a Transnational NGO Network', *Review of European, Comparative & International Environmental Law*, 10(2): 177–89.
- Fletcher, Robert and Crelis Rammelt. 2017. 'Decoupling: A Key Fantasy of the Post-2015 Sustainable Development Agenda', *Globalizations*, 14(3): 450–67.
- Goodman, James. 2009. 'From Global Justice to Climate Justice? Justice Ecologism in an Era of Global Warming', *New Political Science*, 31(4): 499–514.
- Government of India (GoI). 2015. 'India's Intended Nationally Determined Contribution: Working towards Climate Justice'. Available at <http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf>; accessed on 22 May 2018.
- Gough, Clair and Simon Shackley. 2001. 'The Respectable Politics of Climate Change: The Epistemic Communities and NGOs'. *International Affairs*, 77(2): 329–46.
- Guha, Ramachandra and Joan Martinez-Alier. 1997. *Varieties of Environmentalism: Essays North and South*. New Delhi: Routledge.
- Harms, Arne and Oliver Powalla. 2014. 'India—The Long March to a Climate Movement', in Matthias Dietz and Heiko Garrelts (eds), *Routledge Handbook of the Climate Change Movement*, pp. 179–93. Abingdon: Routledge.
- Howe, Joshua P. 2016. *Behind the Curve: Science and the Politics of Global Warming*. Seattle: University of Washington Press.

- Hulme, Mike. 2009. *Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity*. UK: Cambridge University Press.
- Isaksen, Kari-Anne and Kristian Stokke. 2014. 'Changing Climate Discourse and Politics in India: Climate Change as Challenge and Opportunity for Diplomacy and Development', *Geoforum*, 57(November): 110–19.
- Khastagir, N. 2002. 'The Human Face of Climate Change: Thousands Gather in India to Demand Climate Justice', *Corporate Watch*, 4 November. Available at <https://www.globalpolicy.org/component/content/article/211/44309.html>; accessed 15 May 2018.
- Kluttz, Jenalee and Pierre Walter. 2018. 'Conceptualizing Learning in the Climate Justice Movement', *Adult Education Quarterly*, 68(2): 91–107.
- Koukouvelis, Kostas. 2017. 'Climate Change Social Movements and Cosmopolitanism', *Globalizations*, 14(5): 746–61.
- Kukkonen, Anna, Tuomas Ylä-Anttila, Pradip Swarnakar, Jeffrey Broadbent, Myanna Lahsen, and Mark C.J. Stoddart. 2018. 'International Organizations, Advocacy Coalitions, and Domestication of Global Norms: Debates on Climate Change in Canada, the US, Brazil, and India', *Environmental Science & Policy*, 81(March): 54–62.
- Kuyper, Jonathan, Karin Bäckstrand, and Heike Schroeder. 2017. 'Institutional Accountability of Nonstate Actors in the UNFCCC: Exit, Voice, and Loyalty', *Review of Policy Research*, 34(1): 88–109.
- Lele, Sharachandra. 2012. 'Climate Change and the Indian Environmental Movement', in Navroz K. Dubash (ed.), *Handbook of Climate Change and India: Development, Politics and Governance*, pp. 208–17. New Delhi: Oxford University Press.
- Martinez-Alier, Joan. 2014. 'The Environmentalism of the Poor', *Geoforum*, 54: 239–41.
- Oivo, Katariina. 2014. 'Inspired Justice Environmentalism: Action and Moral Argumentation of Indian Civil Society on Climate Change', Masters Dissertation, University of Helsinki.
- Okereke, Chukwumerije and Philip Coventry. 2016. 'Climate Justice and the International Regime: Before, During, and After Paris', *Wiley Interdisciplinary Reviews: Climate Change*, 7(6): 834–51.
- Pettit, Jethro. 2004. 'Climate Justice: A New Social Movement for Atmospheric Rights', *IDS Bulletin*, 35(3): 102–6.
- Planning Commission. 2014. *The Final Report of the Expert Group on Low Carbon Strategies for Inclusive Growth*. New Delhi: Government of India.
- Raghunandan, D. 2012. 'India's Climate Policy: Squaring the Circle', *IDS Bulletin*, 43(s1): 122–9.
- Ray, M., N. Doshi, N. Alag, and R. Sreedhar. 2011. 'Climate Vulnerability in North Western Himalayas', A contribution to the ongoing nation-wide

- climate studies vulnerability in various eco-regions of India, Indian Network on Ethics and Climate Change.
- Roberts, J. Timmons and Bradley C. Parks. 2009. 'Ecologically Unequal Exchange, Ecological Debt, and Climate Justice: The History and Implications of Three Related Ideas for a New Social Movement', *International Journal of Comparative Sociology*, 50(3–4): 385–409.
- Rowell, Andrew. 1996. *Green Backlash: Global Subversion of the Environment Movement*. Routledge.
- Roy, Dunu. 2015. 'A Subaltern View of Climate Change', *Economic & Political Weekly*, 50(31): 31–9.
- Schlosberg, David and Lisette B. Collins. 2014. 'From Environmental to Climate Justice: Climate Change and the Discourse of Environmental Justice', *Wiley Interdisciplinary Reviews: Climate Change*, 5(3): 359–74.
- Sen, Siddhartha. 1999. 'Some Aspects of State–NGO Relationships in India in the Post-Independence Era', *Development and Change*, 30(2): 327–55.
- Shakti Sustainable Energy Foundation (SSEF). 2018. *Integrating Renewable Energy Modelling with Power Sector Planning for India: Production and Reliability Simulations for 2022*. New Delhi: SSEF.
- Sridhar, Harshid, Thirumalai N.C., Vaishalee Dash, and Mridula D. Bharadwaj. 2018. *Transition to All-Electric Public Transportation: Energy Resource Assessment*. Bangalore: Center for Study of Science, Technology and Policy.
- Srinivasan, U. Thara, Susan P. Carey, Eric Hallstein, Paul A.T. Higgins, Amber C. Kerr, Laura E. Koteen, Adam B. Smith, Reg Watson, John Harte, and Richard B. Norgaard. 2008. 'The Debt of Nations and the Distribution of Ecological Impacts from Human Activities', *Proceedings of the National Academy of Sciences*, 105(5): 1768–73.
- Swarnakar, P. and T. Ylä-Anttila. 2016. 'Social Movement Organizations, Epistemic Communities or a "Third Sector"? The Divergent Roles of Indian Civil Society Organizations in Policy Networks of Climate Change', Third ISA Forum of Sociology, Vienna, 10–14 July.
- Talukdar, Ruchira. 2018. 'Reigniting a Debate on Coal: Case Study on the Indian Government's Crackdown on Greenpeace', *Cosmopolitan Civil Societies: An Interdisciplinary Journal*, 10(1): 47–62.
- Tarrow, Sidney. 1994. *Power in Movement: Social Movements, Collective Action and Mass Politics*. UK: Cambridge University Press.
- The Energy and Resources Institute (TERI). 2016. *Strategizing Nationally Appropriate Mitigation Actions in India*. Report 2013GW13. New Delhi: TERI.
- Venkat, V. 2016. 'India Demands "Climate justice"', *The Hindu*, 2 December. Available at <http://www.thehindu.com/news/international/India-demands-%E2%80%98climate-justice%E2%80%99/article16643833.ece>; accessed on 5 May 2018.

- Vihma, Antto. 2011. 'India and the Global Climate Governance: Between Principles and Pragmatism', *The Journal of Environment & Development*, 20(1): 69–94.
- Ylä-Anttila, Tuomas and Pradip Swarnakar. 2017. 'Crowding-in: How Indian Civil Society Organizations Began Mobilizing around Climate Change', *The British Journal of Sociology*, 68(2): 273–92.
- Ylä-Anttila, Tuomas, Pradip Swarnakar, Sadaf Javed, and Katariina Oivo. 2015. 'How to Avoid Seeing Like a State: Learning from CSOs', *Economic & Political Weekly*, 50(17): 14–16.

Business Action on Climate Change

A Perspective from the Private Sector

Shankar Venkateswaran and Mukund Rajan

Two independent events in the 1990s set the stage for highlighting the role that businesses in India might play in addressing climate change. One was the World Conference on Environment and Development in Rio de Janeiro in 1992 that brought about a global focus on the environment and recognized that human action was a significant contributor to climate change. The second was a significant shift in Indian economic policy: the ushering in of liberalization, privatization, and globalization of the economy meant an increasing role for business in economic development.

While it must be said that a number of Indian businesses remained conscious about their responsibilities to communities, especially given India's poor state of human development, liberalization also meant competing with global players. The main concerns of business—profitability, growth, longevity, and shareholder returns—began to dominate Indian business thinking, with social and environmental responsibilities sometimes taking a back seat. Also, the

regulatory framework emphasized pollution, deforestation, and wildlife conservation, and that relatively narrow focus dominated the environmental discourse.

The last decade or two seem to have brought in a greater degree of balance between the financial bottom line on the one hand, and the social and environmental bottom lines on the other, thereby bringing climate change to the forefront. Several factors have influenced this change, including global initiatives, stronger community and civil society responses, as well as internal drivers and thought processes. Mounting scientific evidence of the causes and impacts of climate change have placed this issue squarely on the agenda. This chapter explores these influences, examines the responses of companies, and identifies the challenges that companies in India face in integrating climate change more holistically into their business models.

Business and Climate Change: The Tide Is Turning Globally

Though far from a consensus, the number of global companies that not only recognize the reality of climate change but are also acting on it has increased dramatically, especially in the past 5–10 years. According to CDP (formerly Carbon Disclosure Project; www.cdp.net), the number of companies reporting on climate change grew from 245 at launch in 2002 to 6,251 in 2017. Moreover, according to CDP, in 2017, about 89 per cent of reporting companies had emission targets in place and by May 2018, 401 companies had committed to setting science-based targets, up from 114 in the year 2015!

Slowly but surely, the tide is turning. The significance of developments during 2015, which saw the adoption of the Sustainable Development Goals (SDGs) at the UN General Assembly as well as the Paris Agreement on climate change, was not lost on companies. These processes actively encouraged the participation of chief executive officers (CEOs) of corporations who, perhaps for the first time, were invited to sit at the table and not on the sidelines. We, too, were present in Paris and participated in several discussions where business leaders were invited to speak in meetings chaired by the UN secretary-general and other leaders. Global industry bodies such as the World Business Council for Sustainable Development (WBCSD) and the World Economic Forum (WEF), and through them their

member companies, were actively engaged in the discussions leading up to the SDGs and the Paris Agreement. These organizations also coordinated open letters from CEOs to political leaders ahead of the Paris Agreement (WEF 2015), urging them to build global covenants which businesses would support. Many also responded publicly and positively to the appeal by the We Mean Business Coalition (We Mean Business n.d.) to companies to publicly commit themselves to goals such as using 100 per cent renewable energy, adopting science-based emission targets, and putting a price on carbon.

The Paris Agreement provided the much-needed momentum for businesses to make their commitment to addressing climate change public, and this commitment has been sustained. The Michael Bloomberg-led Task Force on Climate-Related Financial Disclosures (TCFD), which also included an Indian representative from Tata Steel, has recommended a framework for climate reporting which several companies have endorsed. Several global CEOs, in July 2017, openly urged the G20 leaders to accept the TCFD recommendations (Farnworth 2017). In fact, several CEOs of US companies publicly urged President Trump not to pull out of the Paris Agreement and when he still went ahead and announced his intention to do so in June 2017, they not only openly criticized him but also pledged that their companies would continue to honour those commitments (Horowitz and Mullen 2017).

What Is Moving the Needle?

While some global businesses have always shown leadership by focusing on stakeholder value, it would be fair to say that the triggers are not all altruistic. So, where is this motivation coming from?

There are, indeed, several businesses that believe that climate change is anthropogenic and that businesses have to be part of the solution. At the same time, they recognize that markets do not always reward responsible behaviour, especially in the short term, and arguably the only way of ensuring a level playing field is through state action. This would partly explain why so many business leaders urged global political leaders to come to an agreement at Paris, and later also appealed to the G20 heads of state to endorse the TCFD recommendations.

Even if CEOs are convinced that conducting business responsibly, beyond complying with the law, is good for business, they look for the ‘business case’ to convince their stakeholders. Apart from regulations getting tighter, this ‘business case’ is increasingly being provided by stakeholder pressure. Some examples are:

1. Investors, whose actions, as one private investor said to us, are driven by fear and greed, see climate change as a risk to their investments as well as an opportunity for new businesses, for example, renewables. The action by global investors to force Exxon to agree to disclose its carbon emission (*Fortune* 2017) and Norges Bank exiting its fossil fuel holdings are just two examples of the former. When CDP asked 354 investors to approach around 1,300 high environment impact companies with their Investor Action request to take 3 specific sets of actions, 63 per cent of the companies had responded by 2017 (Stathers 2018).
2. Surveys increasingly show that customers and employees prefer brands and companies with a purpose. Recent data showed that Unilever brands that were aligned with their ‘Sustainable Living Plan’ grew faster than others (Unilever 2017).
3. Other stakeholders, like communities, non-governmental organization (NGOs), and media, are beginning to indicate their preference for companies that demonstrate responsible behaviour. However, it must be said that this driver is still emergent.

Business membership organizations—both global, like the WEF and WBCSD, and Indian, like the Confederation of Indian Industry (CII) and the Federation of Indian Chambers of Commerce and Industry (FICCI)—are increasingly working with their members to mainstream thinking on sustainable development, including climate change. They do this in a number of ways, including rewards and recognition, conferences, providing evidence from their members on the business benefits, and, increasingly, working with their members to develop solutions to address climate change concerns. While businesses compete in the marketplace, it appears that sustainable development can incentivize collaboration, as envisaged by SDG 17 on partnerships. For example, the authors learnt during discussions with colleagues at the Tata Group-owned Jaguar Land Rover that its

commitment to lightweighting and circularity led it to collaborate with the Aditya Birla Group's aluminium company Novelis, which recycles aluminium and supplies the former recycled aluminium.

Indian Companies Too Have Begun to Get Active, Some More than Others

Businesses in India too have begun to engage on sustainable development issues in general, and climate change in particular. Evidence of this is:

1. Eight Indian CEOs signed the WEF statement supporting political leaders to come to an agreement at Paris (WEF 2015).
2. Over 50 companies reported regularly on their carbon emissions to CDP in 2017 and 2018, though this is lower than the peak of 61 reached in 2015, the year of the Paris Agreement (CDP Climate Change Report 2015 and subsequent editions of this report).
3. Indian companies are already thinking about and experimenting with an internal carbon price. Seven have joined the World Bank-led Carbon Pricing Leadership Coalition (Carbon Pricing Leadership Coalition n.d.). Mahindra, Hindustan Construction Company, and Infosys have made public announcements about their internal carbon pricing, while some Tata companies are doing this as an internal exercise. Importantly, 40 companies in 2017 reported to CDP that they either had an internal price on carbon (14) or were intending to develop this within 2 years (26), up from 27 in 2015 (CDP and TERI 2017: 18).

Is there a typical pathway that Indian companies have taken to internalize and mainstream climate change into their core operations? Perhaps not, but it would be fair to say that there are some indicators to look out for.

The first sign that a company is getting serious about the larger sustainability agenda (and climate change is often an important part of this for manufacturing companies) is voluntary sustainability reporting, using global frameworks like the Global Reporting Initiative (GRI), CDP, and, in the odd case, Integrated Reporting.

Interestingly, many companies have begun their sustainability journey by, first, writing their sustainability reports, and then realizing that they need to become more strategic if successive reports are to demonstrate real progress. Based on the authors' analysis of the GRI's Sustainability Disclosure database (<https://database.globalreporting.org/search/>), the numbers are still small but are rising, from about 27 reports in 2010 to 85 reports in 2015.

A second sign is the creation of a sustainability team in a company, initially housed in the environment, health, and safety (EHS) or corporate social responsibility (CSR) teams, leading eventually to the appointment of a chief sustainability officer (CSO). Five years ago, a CSO would have been a rarity in Indian companies and while it is still not common, it certainly is gaining ground. However, it would be rare to see any company of significance not having someone reasonably senior in charge of CSR and environment (including climate change), either separately or as an integrated function. Interestingly, in the case of groups like the Tata, Mahindra, and Aditya Birla, such positions exist at both group and individual company levels.

A third stage in this journey is sustainability becoming strategic and getting mainstreamed in companies. This would include activities such as systematically engaging with stakeholders to understand their expectations, as well as analysing the environment and social issues, including climate change, that are likely to impact financial results over time. This process leads to the identification of key 'materiality' considerations, and often results in a more systemic and robust sustainability report. At a later stage, companies move to the next level, including their supply chains and distribution channels in their sustainability strategy, investing in clean technologies, and embracing ideas like circularity.

In many ways, the journey of the Tata Group, with whom we have worked and with which we are familiar, is illustrative. The group has, for the longest time, believed that communities are the very reason for a business's existence and, therefore, it created a Tata Council for Community Initiatives to collectively work on this. Most major companies in the group signed on to the UN Global Compact and began reporting against that. In 2009, the group articulated its climate change policy, which urged group companies to adopt a leadership role. This resulted in several group companies calculating their carbon and water footprints and investing in reducing them. In

2014, the group established the Tata Global Sustainability Council (TGSC), which adopted a comprehensive sustainability policy and a set of group key performance indicators to track performance. Many companies also began to report using the GRI framework.

In 2015, the group began to explore how internal carbon pricing can mainstream climate change mitigation thinking. A task force consisting of major carbon-emitting companies was set up, which decided that: (i) given its diversity, a uniform carbon price for the whole group will not be viable; and (ii) the mechanism used should be a shadow price that pushes capital investments down a low-carbon path. Tata Steel uses this for its capital expenditure proposals, while Tata Power, the other big emitter, obviated the need for this by committing to generate 30–40 per cent of its power production from renewables by 2025 (Shah 2016).

Varied Pace of Adoption

Expectedly, given the diversity of Indian industry, the engagement with climate change varies across businesses. Large companies and groups, especially those with a global footprint, have taken the lead, as they must. This has been driven by several factors, including stricter regulations and their implementation in overseas markets and more active and vocal stakeholders, like customers and investors.

There are also sectoral differences in the speed at which climate mitigation measures are mainstreamed. Even though the renewables pathway to decarbonization of the electricity sector is clear, electricity companies in India are still heavily invested in coal-based technologies; the good signs are that companies like Tata Power have made public commitments to shift significantly to renewables (Shah 2016). Sectors like aviation, heavy transport, steel, and cement—what the Energy Transitions Commission (n.d.) called the ‘harder to decarbonise’ sectors in its report—will have to depend upon technological advances (including carbon capture and storage/use in the case of the latter two) to reduce their carbon emissions and may end up emitting carbon for a longer time than other sectors.

While a few leading Indian companies are walking the talk, it would be fair to say that many others are still struggling with

embracing the agenda—in part because they do not fully understand the implications and partly because of their focus on the short term. The micro, small, and medium enterprise (MSME) sector in India, many of whose members are part of supply chains of larger companies, is the harder nut to crack. This segment is particularly significant as it accounts for about a third of India's gross domestic product (GDP) and industrial output (CII n.d.) and employs over 120 million people, second only to agriculture! In the absence of any signals from customers, regulators, or the banking system on the importance of sustainability in general, and climate change in particular, and because price continues to dominate the narrative in India, MSMEs see little incentive to look at the medium to long term and invest in technologies or processes that could positively impact climate change. Here is where large companies that have understood the implications of climate change can play a significant role in influencing their MSME value chain partners in becoming more proactive. However, it must be said that work on sustainable supply chains even amongst large companies is still in its infancy in India.

Challenges Remain

While a case can be made for businesses to reflect on their own role in society and not wait for the 'business case' to be made before embracing sustainability, only a few leadership companies will actually do this in practice. Therefore, there remains a strong need for external forces to also push the 'business case' and this is where several challenges remain for businesses in general, and Indian businesses in particular. Some of these are explored here.

Regulation remains the key because, as mentioned earlier, it can both encourage and provide a level playing field to businesses who wish to take the agenda forward. However, regulatory signals remain mixed. Some policy interventions, such as the coal cess and the emphasis on renewable energy, signal the government's seriousness on climate change, but at the same time, the coal ministry does talk about increasing coal production; little has been done to get more companies to, for instance, disclose their carbon emissions, or report on their low-carbon investments, or initiate discussions on carbon pricing as a means to address mitigation.

When it comes to taking public positions and leading the advocacy agenda in favour of climate change mitigation and adaptation, it must be said that Indian industry has not been very proactive, especially compared to its developed country counterparts. There have been occasions when businesses have pushed back on tighter regulations; Chattopadhyay (2015) reported that ‘pressure from the automobile industry is delaying implementation of tighter vehicular emission norms in cities across India’. The Bharat Stage (BS) VI emission norms are to come into effect from 2020, bypassing BS V, and while companies say they are gearing up for this, issues around fuel availability and clearing of unsold stocks are being raised. There have been difficulties in building an industry-wide consensus, with some companies being focused on the short-term and being concerned about getting rid of the stock of vehicles that are non-compliant before the deadline. Predictability of regulations is also a challenge—the more advanced fuel standard, BS VI, was advanced to 2018 for Delhi in light of terrible air quality in many Indian cities; companies argue that there was insufficient time to prepare.

Few Indian investors, if any, are factoring sustainability into their decisions, and hence signals from the Indian investment community are nowhere near comparable to those that global investors see. There have been attempts from the National Stock Exchange and the Bombay Stock Exchange to build indices on sustainability and carbon, but there are few signs, for instance, of funds that use these indices to provide investment opportunities. Anecdotally, more Indian companies are keen to be on the Dow Jones Sustainability Index than comparable Indian stock market indices.

Markets in India still do not reward responsible behaviour. India remains a price-conscious market and customers—both industrial and retail—are not ready to pay a higher price in the short term associated with sustainable production. There are early signs that the other stakeholder that businesses take seriously, namely, employees, are preferring to join companies that exhibit responsible behaviour, but this is far from being a significant game changer.

While leadership companies have begun to factor sustainability thinking (including climate change) into their business strategies and models, the process clearly needs to be deeper, wider, and faster. This requires, at the minimum, a level playing field where all businesses are driven to contribute; regulations can provide this but few businesses beyond the leadership ones can be expected to advocate for this. However, unless all the other stakeholders—customers (which include governments which are significant procurers of goods and services in India), investors, employees, communities, etc.—reward such behaviour, business as a sector will change slowly. There is sufficient evidence that businesses, both global and Indian, now understand the impacts of climate change, their role in causing it, and their ability to provide solutions. This is an opportune moment to demonstrate that doing business responsibly is the key to success.

References

- CDP Climate Change Report. 2015. 'India Inc. Prepares to Tackle Environmental Risks', Appendix I, pp. 27–8. New Delhi: Carbon Disclosure Project India.
- CDP and TERI. 2017. 'Putting a Price on Carbon: A Handbook for Indian Companies'. New Delhi: Carbon Disclosure Project India.
- Carbon Pricing Leadership Coalition. n.d. 'Why is Everyone Talking about Carbon Pricing?'. Available at <https://www.carbonpricingleadership.org/>; accessed on 30 May 2018.
- Confederation of Indian Industry (CII). n.d. 'Micro, Medium & Small Scale Industry'. Available at <http://www.cii.in/Sectors.aspx?enc=prvePUj2bdMt gTmvPwwisYH+5EnGjyGXO9hLECVtNuXK6QP3tp4gPGuPr/xpT2f>; accessed on 30 May 2018.
- Chattopadhyay, Vivek. 2015. 'New Auto Emission Norms Delayed: Automobile Manufacturers Unprepared', *DownToEarth*. Available at <https://www.downtoearth.org.in/news/new-auto-emission-norms-delayed-644>.
- Energy Transitions Commission. n.d. 'Better Energy, Greater Prosperity'. Available at <http://www.energy-transitions.org/better-energy-greater-prosperity>; accessed on 30 May 2018.
- Farnworth, Emily. 2017. 'Global CEOs Call for Greater Disclosure of Climate Risks and Opportunities'. Available at <https://www.weforum.org/agenda/2017/04/global-ceos-call-for-greater-disclosure-of-climate-risks-and-opportunities/>; accessed on 30 May 2018.

- Fortune*. 2017. 'ExxonMobil Gives in to Shareholders on Climate Risk Disclosure'. Available at <http://fortune.com/2017/12/12/exxon-mobil-climate/>; accessed on 30 May 2018.
- Global Reporting Initiative (GRI). 2016. *Sustainability Integration: Corporate Reporting Practices in India*. Mumbai: Global Reporting Initiative, Indian Institute of Management Bangalore, and Tata Consultancy Services.
- Horowitz, Julia and Jethro Mullen. 2017. 'Top CEOs Tell the CEO President: You're Wrong on Paris'. *CNN*, Available at <http://money.cnn.com/2017/06/01/news/ceos-respond-trump-paris-agreement/index.html>; accessed on 30 May 2018.
- Shah, Rahul. 2016. 'Tata Power to Focus on Renewable Energy', *The Tribune*, 22 December. Available at <http://www.tribuneindia.com/news/business/tata-power-to-focus-on-renewable-energy/340003.html>; accessed on 11 June 2019.
- Stathers, Rick. 2018. 'Moving beyond Disclosure and Driving Action'. Available at <https://www.cdp.net/en/articles/investor/moving-beyond-disclosure-and-driving-action>; accessed on 30 May 2018.
- Unilever. 2017. 'Unilever's Sustainable Living Brands Continue to Drive Higher Rates of Growth'. Available at <https://www.unilever.com/news/Press-releases/2017/unilevers-sustainable-living-brands-continue-to-drive-higher-rates-of-growth.html>; accessed on 30 May 2018.
- We Mean Business. n.d. 'Take Action'. Available at <https://www.wemean-businesscoalition.org/take-action/>; accessed on 30 May 2018.
- World Economic Forum (WEF). 2015. 'These 79 CEOs Believe in Global Climate Action'. Available at <https://www.weforum.org/agenda/2015/11/open-letter-from-ceos-to-world-leaders-urging-climate-action/>; accessed on 30 May 2018.

Energy and Climate Change

A Just Transition for Indian Labour

Ashim Roy, Benny Kuruvilla, and Ankit Bhardwaj

The 2015 Paris Agreement gives momentum to the global response to climate change. The stated goal to keep global temperature rise to well below 2°C from pre-industrial levels by this century places onus on both developed and developing countries to embark on a low-carbon developmental pathway. The Government of India's (GoI) Intended Nationally Determined Contribution (INDC) to the Paris Agreement indicates that it too has this ambition (GoI 2015). While the country posed ambitious targets to decarbonize its economy (Mathur, Chapter 13), the submission also carried the subtitle, 'Working towards Climate Justice', and insisted that further decarbonization can be achieved with the help of transfer of technology from developed countries and low-cost international finance from sources such as the Green Climate Fund (GCF). This reflects India's long-standing diplomatic position on addressing global inequality while addressing climate change. The Paris Agreement's preamble also notes that parties to the agreement are '[t]aking into account the

imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities' (United Nations Framework Convention on Climate Change [UNFCCC] 2016: 2), placing questions of justice squarely amidst national deliberations. Climate justice then, whether in global or national terms, seems well and truly mainstream. Less acknowledged, at least explicitly, is that changes in terms of justice will also require radical transformation of our social relations (Morgan 2016).

Climate change and our response to it will bring immense changes to the economy and society. Will these changes reinforce existing unequal structures, or reform and revolutionize them? The burden of change may well fall upon the poorest and the most vulnerable. Also, workers will be central to building this new low-carbon world, but will likely not receive all its benefits (Li 2009). A just transition is then one that is created in consideration of those burdened with the transition. This is why large international federations of labour unions, such as the International Trade Union Confederation (ITUC), have actively lobbied for the inclusion of just transition clauses into the language of the Copenhagen, Cancun, and Paris agreements (Räthzel et al. 2010; Sweeney and Treat 2018). These unions are calling to be involved in the sweeping and radical 'industrial transformation' required and demanding a just transition, 'including through investment in new green jobs, skills, income protection and other necessary measures implemented everywhere, with adequate funding for the poorest and most vulnerable of nations' (ITUC 2014: 2). These ideas were also reflected in a platform by a global initiative of trade unions called Trade Unions for Energy Democracy (TUED), which placed on the agenda resisting private control of energy and reclaiming public, democratic control (Sweeney 2012: 31). Central to these positions then is reorienting the energy system from market to social concerns by asserting democratic control.

Informed by the Indian government's diplomatic call for global climate justice and on international trade unions' positions on 'just transitions', this chapter lays out the questions, opportunities, and barriers for a just transition in India. It will first develop what 'just transition' means in India's own material and political context, focusing globally on India's 'right' to development and domestically on

worker roles in a privatizing energy sector and the impact of climate change on worker conditions. It will then outline how trade unions are putting worker and social concerns central in their proposals for a just transition in India.

Terrain for a Just Transition in India

The concept of a just transition draws lineage from scholarship on ‘environmental justice’ and ‘climate justice’ (Agyeman et al. 2016; Mohai, Pellow, and Roberts 2009; Parks and Roberts 2010; Temper et al. 2018) which, acknowledging the importance of reducing emissions, has contextualized climate change within global inequality and uneven development. Globally, workers often have borne the brunt of current arrangements of production, which are dependent on control of labour and cheapening of work, care, and energy (Malm 2016; Patel and Moore 2018). In response, global unions have been pushing for a ‘just transitions’ perspective in global climate frameworks and have focused on achieving democratic control over energy systems, support for vulnerable nations and groups, and the creation of new green and low-carbon economies and forms of production through an active leadership role by unions (Burke and Stephens 2017; Räthzel and Uzzell 2011, 2012; Räthzel, Uzzell, and Elliott 2010; Stevis and Felli 2015; Sweeney 2012).

Alongside global unions, national unions have begun to strategize for a just transition in their country’s material and political terrain, seeking to understand how climate change is impacting workers and reorienting the economy (Räthzel and Uzzell 2011; Snell and Fairbrother 2011). In the developing world, unions have formulated positions sensitive to their country’s development needs. South Africa’s largest union, the National Union of Metal Workers of South Africa (NUMSA), has advanced deliberations on renewables and energy efficiency, and also been active in struggles to keep electricity affordable and in public control (Satgar 2015). This focus on development needs is relevant to India as many still do not have access to basic social services, exacerbating vulnerability to climate impacts. A just transition in India will then have to be based upon the need for development and growing climate vulnerability of workers, and also the particular material and political

arrangements of India's energy sector, the primary site of a transition to a low-carbon economy.

First, because of India's low levels of development, few in India have the economic or material basis, and necessary access to social infrastructure such as health care coverage to be adequately sheltered from climate impacts. Despite the recent announcement from the National Democratic Alliance (NDA) government on 100 per cent electrification across rural India, and the country producing surplus electricity, quality of access to households, and other critical social infrastructure such as health centres is still limited (Dholakia 2018; Jain et al. 2015). As a result, alongside imperatives to reduce emissions, India has a 'right to develop', making accessible modern energy and social infrastructure to help in the adaptation of climate change (Mathews, Barria, and Roy 2016). This need, along with India's lower historical emissions compared to other large emitters, forms the basis of India's claim to the global carbon budget (Kanitkar and Jayaraman, Chapter 6 in this volume). As a result, a just transition for India is not one solely aimed at decarbonization, but also the extension of modern energy and services to those that lack it.

Second, with or without social safety nets, India and its workers will be particularly prone to climate change. Climate change is projected to decrease productivity and increase absenteeism due to heat stress (Somanathan et al. 2017). Workers in heat-exposed environments and locked into pervasive informal agreements, such as migrant brick-kiln workers, are particularly precarious (Lundgren-Kownacki et al. 2018; Sett and Sahu 2014). Increased exposure to unhealthy work environments, along with lower productivity, will change bargaining grounds. It will also increase burdens of health costs on households and carers (Pandey et al. 2018; Tran et al. 2013) and dependence on social amenities and infrastructure.

A just transition in India will be a balancing act between quickly providing modern services to those most burdened while also transitioning towards a lower-carbon economy. While this balance is relevant across industries, it will primarily play out in how India's energy sector will change in light of climate change. The role of labour organizations will be significant. Labour struggles have historically leveraged their control over energy systems to demand changes in the larger economy. For example, in the United Kingdom (UK),

miners, dock workers, and railwaymen frequently organized to cripple the country's energy system (Mitchell 2011). More recently, energy systems have been restructured, privatized, and reorganized by those in power, in response to such labour struggles and demands (Mitchell 2011). Energy has been the 'material terrain' upon which labour struggles have played out (Malm 2016). The particularities of India's energy institutions and trends will determine the programme of India's just transition, which will involve the prudent usage of coal for development while peaking its usage sooner and transition to renewables faster. Three aspects stand out: historic public ownership that faces pressures of privatization; a history of resistance from unions and social movements, especially against mega-projects; and coal's entanglement with the livelihoods of the poorest regions of the country.

First, India's energy system, especially the coal sector and electricity distribution companies, has historically been under public state ownership. However, post liberalization of the economy, several attempts have been made for privatization of the entire supply chain: from mining to energy production to distribution. There has been consistent resistance by workers in the power sector to further liberalization. These include opposition to commercial coal mining, the proposed 2014 amendments to the national Electricity Act that allow for further division of the electricity industry, and increasing contractualization of workers and the depletion of funds to state electricity boards. The privatization of electricity distribution in states such as Odisha has failed, with the private companies unable to reduce losses, address corruption, and improve efficiency and services (Purkayastha 2016). The entire energy distribution in the state of Odisha has already reverted back to state ownership (Mohanty 2015). The 2003 Electricity Act also allowed private players in generation and has led to over 40 per cent generation of power from the private sector; however, this has a flip side. Public and private banks are now saddled with a large amount of bad loans with numerous failed projects and faulty power purchase agreements (PPAs) have burdened state electricity boards with expensive power from private players (Parliamentary Standing Committee on Energy 2018). There have also been several cases of corruption in allocating coal blocks (Nileena 2018). The uptake of renewables,

though welcome, has also been capital intensive and led by private sources of finance.

Second, India's history of energy is also one of resistance from social movements, especially of groups displaced by mega coal, nuclear, and hydro energy projects. This is mostly led by local communities who are concerned about the loss of land, livelihoods, inadequate compensation from state authorities, and health and environmental impacts of living in the vicinity of polluting projects (Bhumi Adhikar Andolan 2016). Renewables too are land intensive. As large solar parks and wind farms get sanctioned, resistance is mounting against land acquisition for renewable energy as well.

Last, coal dominates India's energy landscape. Important to any talk of transition are India's coal-producing areas in the eastern states of Chhattisgarh, Jharkhand, Odisha, Madhya Pradesh, and Telangana, where entire economies, societies, and livelihoods are oriented around coal. While rich in minerals, these states are also India's poorest and least resourced by social infrastructure (Bhushan 2008). They are also home to large concentrations of historically discriminated Adivasi populations. The impact of transitions away from coal will be centred on these areas.

An Indian just transition will have to be located upon India's 'right to develop', the need to peak coal usage soon and transition to renewables, increased worker and social vulnerability to climate impacts, privatization of the energy sector, history of resistance to displacement, and the livelihoods of those in underdeveloped parts of the country. How are unions navigating this terrain?

Trade Union Responses: The Case of the New Trade Union Initiative

Among the trade unions grappling with the idea of 'just transitions' in India is the New Trade Union Initiative (NTUI, a non-party, independent labour initiative founded in 2006. The NTUI's engagement with just energy transition is based on ensuring India's right to develop, where industrialization is still required as part of a process of expansion of economic activity, and to create social infrastructure such as schools, hospitals, and public transport for broader welfare. For India, a just transition will not only require economic growth and

increased emissions, but also ‘linking the dialogue on emissions with a social justice and development perspective and not to see them as mutually exclusive’ (Mathews, Barria, and Roy 2016: 2). The transition will likely centre on the country’s energy sector. India’s dependence on coal will shape the pathways to develop, and also condition how the country transitions quicker to more low-carbon sources. In the near future, India is projected to see an increase in both coal and renewables (Dubash et al. 2018). As a result, the NTUI’s perspective on India’s transition straddles both the coal sector and the renewable energy sector (Mathews, Barria, and Roy 2016: 12). Questions of distribution also arise.

An Energy Strategy for Social Use

India’s coal sector is currently central to its economy. It is also densely unionized and is a largely public sector owned and managed industry structure. This presents an opportunity to reorient the sector towards broader worker and social welfare as it faces an eventual phase-out. However, pervasive informalization of labour through contract work and the rise in private sector involvement undercut this potential. The focus of a just transition from coal should be to ensure that the energy produced is directed towards social use and adheres to the highest environmental standards, irrespective of impacts on profits. This is not possible if the transition to newer, more efficient super-critical coal plants is led by the private sector and financed by private sources, as investors locked into their fossil-fuel investment will have an interest in running plants at full capacity in order to provide economic returns, rather than using the energy produced for social use or solely as a back-up for a renewable energy-led system. Therefore, resistance to the privatization trend in the sector is central to ensure that new investments in coal are dedicated towards public interests and decarbonization. For this, appropriate institutional arrangements should be developed. Imperatives to mitigate greenhouse gas emissions also call for an earlier peak in coal usage, which publically accountable institutions will be best suited to plan for.

The renewable sector (solar and wind) presents a slightly different story, though with a similar programme of response. The

deployment of renewables in India is dominated by private-sector-led mega-projects, propped up by public finance and various tax incentives from the government. Here, a largely contract workforce functions in an environment openly hostile to worker's rights and unionization. There are also indications from other countries that renewables are less labour intensive (Hughes 2017). If private led, workers and social concerns are likely to be sidelined in a low-carbon world's energy sector. To ensure that renewables are deployed for developmental ends, the NTUI's position is to bring renewable energies within a public-sector undertaking (PSU) framework. Renewables will then be part of a broader strategy of industrial development that is not only regulated but also directed by the state, reflecting international trends and recent scholarship making the case for public ownership of renewables to ensure its benefits are distributed socially (Mazzucato 2018; Satgar 2015; Scoones 2016).

The strategic transition towards renewables also calls for a simultaneous approach to training workers to manufacture, install, operate, and dispose of renewable energy and low-carbon technology. This will require a well-coordinated worker training programme, aimed strategically towards building a lower carbon economy. The existence of a renewable energy PSU would make this process much more manageable, in terms of skills identification, methodology, and absorption after retraining. As a result of the existing density and organization of unions in the coal industry (estimated at close to 90 per cent in state-run coal mines), trade unions are uniquely placed to help foster this transition and retraining for renewables, if not other more labour-intensive, low-carbon sectors. The promotion of a union-friendly environment in the emerging low-carbon sectors is thus of paramount importance if a renewable energy transition is also to be a jobs-based transition. A push for public ownership can also help formalize jobs and promote a union-friendly environment. While this is a distant vision in the current market-oriented sector, based on informal labour, the retraining and redeployment of existing unionized coal and thermal workforce for a low-carbon industry can be a strategic first step.

The NTUI proposal is not only about state ownership, management, and labour policy, but also includes a framework for

peoples' direct oversight, where decentralized energy collectives at the local level ensure accountability, for instance, on cost and efficiency. Under this vision, production would be decentralized at appropriate levels to reach a model of production and consumption administrated at the municipality or district level (Mathews, Barria, and Roy 2016: 18–19). This mechanism would ensure that energy systems are oriented towards local social needs. Similar models can restructure the distribution of electricity. For example, to address the continuing challenge of energy access in rural areas, the Kerala Shastra Sahitya Parishad (KSSP) has proposed a three-tiered two-way grid system that would better serve the democratization of energy access. The intent is to operate a local grid, connected to a state grid, itself connected to a national grid, through which households can both produce and draw electricity. Such a grid would be in public hands at each level, forming a system of cooperatives from below at the panchayat level. The KSSP also proposes a South–South technology-sharing mechanism through which India can learn from experiences such as China's rural grids and the Philippines rural energy cooperatives. This focus on ownership of means of production and distribution of energy resonates with TUED's core slogan of the need to reclaim energy systems. In both cases (PSU and energy collectives), the proposition is for trade unions to play a leadership role in formulating and managing these new frameworks in conjunction with other social groups.

The collective focus on coal, renewables, financing, skills development, and democratic management of energy points to the broader strategic importance of an industrial policy and not just a simple regulation of energy markets and institutions. The NTUI's proposals form a framework to shape and guide the industrialization process for developmental and employment ends (Mathews, Barria, and Roy 2016). The public sector and cooperatives are essential institutions that, if developed appropriately, can 'become instruments for exercising political choice in the public interest' (Mathews, Barria, and Roy 2016: 18–19). This framework will also have to be made in awareness of the immense social and economic importance of coal and energy for India's most underdeveloped and under-serviced.

Ensuring Social Welfare in Transition

The roll-out of mega infrastructure in India has frequently been met with wide-scale, sustained, and successful social resistance (Bhumi Adhikar Andolan 2016; Chakravorty 2013). The energy transition for mitigating climate change will bring about changes on how we use land and where infrastructure is located. An additional concern is the rehabilitation of coal areas as coal's dominance eventually reduces with the transition to lower carbon sources. The NTUI sees this as an opportunity to recombine the struggles for land and livelihoods and those of labour. The local economies of coal-bearing areas were destroyed with the entry of coal exploration. On the ashes of what existed, communities recreated economies, this time directly or indirectly dependent on the coal industry. As the transition away from coal dependence reduces the demand for sources of coal currently used, the fragile coal-dependent economies bear the risk of destruction again, leaving behind ghost towns and a degraded environment. State intervention is required to rehabilitate these areas (Mathews, Barria, and Roy 2016). This might be the most ambitious of the components of a just energy transition, as it requires a thorough identification of the impacted areas, involvement from all levels of government, and enough financing to develop alternative livelihood plans. Further, as indicated by the experience of other unions working in coal-dense areas, it also involves linking labour concerns with others in the region equally caught in the web of coal, such as farmers, Adivasis, women, and residents prone to pollution (Krishnan 2017; Narayan 2017). Unions can play a strong role in fostering these rehabilitation transitions, but will also have to formulate a strategy for new energy areas. If targets are to be met, then mega-projects in solar and wind-rich states, such as Rajasthan, Gujarat, Tamil Nadu, Maharashtra, Karnataka, and Madhya Pradesh, can potentially cause the same upheaval that coal exploration did. Solidarity and struggle with the displaced on these fronts will likely be equally important, especially if the renewables sector remains averse to unions.

Experience in India and elsewhere indicates that social welfare in the transition will be dictated by more than simply the outcomes of energy projects. Climate change impacts both the working and social lives of workers, compelling unions to 'down the invisible wall

that exists between workers as workers in workplaces and workers as citizens outside their workplaces' (Räthzel and Uzzell 2011: 1221). This call for unions to engage as social movements is also reiterated in an Indian context, prompting unions to think of workers' lives out of the workplace and to position themselves as a '24 hour union' rather than an 'eight hour' one (Krishnan 2017).

The case of coping with climate change impacts at the workplace provides an illustration. While workers might demand better working conditions, health coverage, and more breaks due to this, scholars note that these demands can also provide imperative to factory owners to automate processes, therefore undercutting labour bargaining power (Somanathan et al. 2017). The 'eight hour' frame here might not be enough. A '24 hour' one will find that most of the recovery and burden of health costs will eventually fall on the households, and mostly women within them (Pandey et al. 2018; Tran et al. 2013). Social services and infrastructure, sensitive to gender, can help prop households coping with the adverse impacts of climate change.

A 'just transition' approach then requires a wider framing than public ownership and orientation of energy infrastructure, to one that encompasses most social infrastructure. Like with energy, the public ownership of essential services is back on the agenda of policymakers across the world. Researchers have documented that since 2000, there are over 835 examples of public services reverting back to public ownership in what is being called 're-municipalization' (Kishimoto, Petitjean, and Steinfort 2017). This draws from a tradition of municipal socialism and seeks to protect vital elements of social infrastructure such as housing, water, and sanitation from speculative private finance and instead, under public and cooperative ownership, orients them for social ends (Becker, Beveridge, and Naumann 2015; Cumbers 2016; Madden and Marcuse 2016). Climate change's wide reach prompts trade unions to be more ambitious.

This chapter serves as a brief introduction to ideas for a just transition to climate change in India. We posit that a just transition will involve public and democratic control over energy and social infrastructure to ensure that development needs are met, and that the shift away

from coal to renewables is not at the expense of workers and the most vulnerable. In the energy sector, this means contesting further privatization, in coal and renewables production and distribution, through a framework of public and cooperative ownership and management. This is especially pressing in the case of renewables, which is dominated by private finance and averse to unionization. Trade unions need to forcefully reassert the importance of public ownership over all energy sources. Further, there is a need to strategize the retraining of workers as part of this broader industrial strategy. Due to the existing union density in coal-rich areas, trade unions can play an active role in formulating a just transition that integrates worker and social concerns.

For this vision to be realized, the existing approach to investment in new technology will need to change and unions will need to argue for public financing. Sources for this are available. For example, revenues from the coal cess levied by the GoI, around Rs 850,000 million from 2010–11 to 2017–18, and tax breaks for private finance can be channelled into public-owned renewables and to retraining workers (Parliamentary Standing Committee on Energy 2019). If India is to reclaim industrial strategy on energy, the requirement is to privilege domestic manufacturing that will create millions of jobs, into which the government can deploy some of the workers from the coal sector who will at some point lose their jobs. It is evident that the private sector will continue to have a role in the energy sector, but it should be a secondary, subservient, and highly regulated role, with the public sector playing the pre-eminent role in an essential service such as energy.

While not addressed in this chapter, this industrial strategy has relevance to other sectors essential to a low-carbon transition, such as the automobile and cement sectors, and also semi-formal sectors, such as transport, waste management, health care, and social care. We hope these linkages are developed going forward. What we do indicate is the need to focus on workers' welfare outside of the workplace. Climate change is likely to impact workers' health and without adequate social infrastructure, the burden will likely fall on households. Further, as we intend to transition away from coal, the livelihoods of those currently dependant on this fuel will have to be supported. Along with retraining and rehabilitating these

spaces, a more radical suggestion, drawing from global trends, is to 're-municipalize' social services and infrastructure to ensure a social safety net for the impacts of climate change.

It thus becomes important to forge an alliance not only between groups in the energy sector—such as those resisting displacement and environmental damage of large projects, including solar and wind parks, and workers in coal plants resisting privatization and demanding better rights—but also movements fighting for social rights and infrastructure. India's climate transition should not only be aimed at the challenges of emissions reductions but also radical and just change towards decent work and social concerns. There is not only a world to save, but a world to win.

References

- Agyeman, Julian, David Schlosberg, Luke Craven, and Caitlin Matthews. 2016. 'Trends and Directions in Environmental Justice: From Inequity to Everyday Life, Community, and Just Sustainabilities', *Annual Review of Environment and Resources*, 41(1): 321–40. Available at <https://doi.org/10.1146/annurev-environ-110615-090052>; accessed on 9 June 2019.
- Becker, Sören, Ross Beveridge, and Matthias Naumann. 2015. 'Remunicipalization in German Cities: Contesting Neo-Liberalism and Reimagining Urban Governance?', *Space and Polity*, 19(1): 76–90. Available at <https://doi.org/10.1080/13562576.2014.991119>; accessed on 9 June 2019.
- Bhumi Adhikar Andolan. 2016. 'National Resolution', Ahmedabad, Gujarat: Bhumi Adhikar Andolan.
- Bhushan, Chandra. 2008. 'Rich Lands, Poor People: The Socio-Environmental Challenges of Mining in India', *Indian Economic Review*, 5(September): 44–53.
- Burke, Matthew J. and Jennie C. Stephens. 2017. 'Energy Democracy: Goals and Policy Instruments for Sociotechnical Transitions', *Energy Research & Social Science, Policy Mixes for Energy Transitions*, 33(Supplement C): 35–48. Available at <https://doi.org/10.1016/j.erss.2017.09.024>; accessed on 9 June 2019.
- Chakravorty, Sanjoy. 2013. *The Price of Land: Acquisition, Conflict, Consequence*. New Delhi, India: Oxford University Press.
- Cumbers, Andrew. 2016. 'Remunicipalization, the Low-Carbon Transition, and Energy Democracy', in The Worldwatch Institute (ed.), *State of*

- the World: Can a City Be Sustainable?*, pp. 275–89. Washington, DC: Island Press/Center for Resource Economics. Available at https://doi.org/10.5822/978-1-61091-756-8_23; accessed on 9 June 2019.
- Dholakia, Hem H. 2018. ‘Solar Powered Healthcare in Developing Countries’, *Nature Energy*, 3(9): 705–7. Available at <https://doi.org/10.1038/s41560-018-0205-1>; accessed on 9 June 2019.
- Dubash, Navroz K., Radhika Khosla, Narasimha D. Rao, and Ankit Bhardwaj. 2018. ‘India’s Energy and Emissions Future: An Interpretive Analysis of Model Scenarios’, *Environmental Research Letters*, 13(7): 074018. Available at <https://doi.org/10.1088/1748-9326/aacc74>; accessed on 9 June 2019.
- Government of India (GoI). 2015. ‘India’s Intended Nationally Determined Contribution: Working towards Climate Justice’. Communicated to UNFCCC Secretariat. New Delhi, India: Government of India. Available at <http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf>; accessed on 10 June 2019.
- Hughes, David McDermott. 2017. ‘A Jobless Utopia?’, *Boston Review*, 15 May. Available at <http://bostonreview.net/class-inequality/david-mcdermott-hughes-jobless-utopia>; accessed on 9 June 2019.
- International Trade Union Confederation (ITUC). 2014. *Unions4Climate Action: Climate Change Is a Trade Union Issue*. Paris, France: ITUC.
- Jain, Abhishek, Sudatta Ray, Karthik Ganesan, Michael Aklin, Cheng Chao-Yo, and Johannes Urpelainen. 2015. *Access to Clean Cooking Energy and Electricity Survey of States*. New Delhi: Council on Energy, Environment and Water.
- Kishimoto, Satoko, Olivier Petitjean, and Lavinia Steinfort. 2017. *Reclaiming Public Services: How Cities and Citizens Are Turning Back Privatisation*. Amsterdam: Transnational Institute.
- Krishnan, Radhika. 2017. ‘The Industrial Project and Organised Labour’, *Economic & Political Weekly*, 52(31): 62–70.
- Li, Minqi. 2009. ‘Capitalism, Climate Change and the Transition to Sustainability: Alternative Scenarios for the US, China and the World’, *Development and Change*, 40(6): 1039–61. Available at <https://doi.org/10.1111/j.1467-7660.2009.01611.x>; accessed on 9 June 2019.
- Lundgren-Kownacki, Karin, Siri M. Kjellberg, Pernille Gooch, Marwa Dabaieh, Latha Anandh, and Vidhya Venugopal. 2018. ‘Climate Change-Induced Heat Risks for Migrant Populations Working at Brick Kilns in India: A Transdisciplinary Approach’, *International Journal of Biometeorology*, 62(3): 347–58. Available at <https://doi.org/10.1007/s00484-017-1476-0>; accessed on 9 June 2019.

- Madden, David and Peter Marcuse. 2016. *In Defense of Housing: The Politics of Crisis*. London and New York: Verso.
- Malm, Andreas. 2016. *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming*. London and New York: Verso.
- Mathews, Rohan D., Susana Barria, and Ashim Roy. 2016. 'Up from Development: A Framework for Energy Transition in India,' Trade Unions for Energy Democracy. Available at <http://unionsforenergydemocracy.org/resources/tued-publications/tued-working-paper-8-up-from-development/>; accessed on 9 June 2019.
- Mazzucato, Mariana. 2018. *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*. UK: Penguin.
- Mitchell, Timothy. 2011. *Carbon Democracy: Political Power in the Age of Oil*. London and New York: Verso.
- Mohai, Paul, David Pellow, and J. Timmons Roberts. 2009. 'Environmental Justice', *Annual Review of Environment and Resources*, 34(1): 405–30. Available at <https://doi.org/10.1146/annurev-environ-082508-094348>; accessed on 9 June 2019.
- Mohanty, Debabrata. 2015. 'Orissa Govt Cancels Licence of 3 Reliance Infra Power Discoms', *The Indian Express* (blog), 5 March. Available at <http://indianexpress.com/article/india/india-others/setback-for-reliance-infrastructure-orissa-power-regulator-cancels-distribution-licence-of-anil-ambanis-company/>; accessed on 9 June 2019.
- Morgan, Jennifer. 2016. 'The Inevitable Transformation—Why Swift Action Is Needed to Stay Below 1.5', *Huffington Post* (blog), 3 November. Available at https://www.huffingtonpost.com/jennifer-l-morgan/the-inevitable-transforma_b_12785940.html; accessed on 9 June 2019.
- Narayan, Shweta. 2017. *Poisoned: Report on the Environmental Sampling around the Coal Mines, Thermal Power Plants and Ash Ponds in Tamnar & Gharghoda Blocks of Raigarh, Chhattisgarh*. Cuddalore, India: Community Environmental Monitoring and Dalit Adivasi Mazdoor Sangathan.
- Nileena, M.S. 2018. 'Coalgate 2.0', *The Caravan*, 1 March. Available at <https://caravanmagazine.in/reportage/coalgate-2-0>; accessed on 9 June 2019.
- Pandey, Rajiv, Juha M. Alatalo, Kavita Thapliyal, Sharmila Chauhan, Kelli M. Archie, Ajay K. Gupta, Shashidhar Kumar Jha, and Manoj Kumar. 2018. 'Climate Change Vulnerability in Urban Slum Communities: Investigating Household Adaptation and Decision-Making Capacity in the Indian Himalaya', *Ecological Indicators*, 90(July): 379–91. Available at <https://doi.org/10.1016/j.ecolind.2018.03.031>; accessed on 9 June 2019.

- Parks, Bradley C. and J. Timmons Roberts. 2010. 'Climate Change, Social Theory and Justice', *Theory, Culture & Society*, 27(2–3): 134–66. Available at <https://doi.org/10.1177/0263276409359018>; accessed on 9 June 2019.
- Parliamentary Standing Committee on Energy. 2018. *37th Report: Stressed/Non-Performing Assets in Electricity Sector*. New Delhi: Lok Sabha Secretariat.
- . 2019. 'Forty Second Report: Stressed/Non-Performing Assets in Gas Based Power Plants'. New Delhi: Lok Sabha Secretariat.
- Patel, Raj and Jason W. Moore. 2018. *A History of the World in Seven Cheap Things: A Guide to Capitalism, Nature, and the Future of the Planet*. London, UK: Verso Books.
- Purkayastha, Prabir. 2016. 'The Crisis of the Power Sector Reforms—Part II', *NewsClick*, 3 December. Available at <http://www.newsclick.in/crisis-power-sector-reforms-part-ii>; accessed on 9 June 2019.
- Räthzel, Nora and David Uzzell. 2011. 'Trade Unions and Climate Change: The Jobs versus Environment Dilemma', *Global Environmental Change*, 21(4): 1215–23. Available at <https://doi.org/10.1016/j.gloenvcha.2011.07.010>; accessed on 9 June 2019.
- (eds). 2012. *Trade Unions in the Green Economy: Working for the Environment*, 1st edition. New York, NY: Routledge.
- Räthzel, Nora, David Uzzell, and Dave Elliott. 2010. 'Can Trade Unions Become Environmental Innovators?', *Soundings*, 46(Winter): 76–87. Available at <https://doi.org/10.3898/136266210793790891>; accessed on 9 June 2019.
- Satgar, Vishwas. 2015. 'A Trade Union Approach to Climate Justice: The Campaign Strategy of the National Union of Metalworkers of South Africa', *Global Labour Journal*, 6(3). Available at <https://doi.org/10.15173/glj.v6i3.2325>; accessed on 9 June 2019.
- Scoones, Ian. 2016. 'The Politics of Sustainability and Development', *Annual Review of Environment and Resources*, 41(1): 293–319. Available at <https://doi.org/10.1146/annurev-environ-110615-090039>; accessed on 9 June 2019.
- Sett, Moumita and Subhashis Sahu. 2014. 'Effects of Occupational Heat Exposure on Female Brick Workers in West Bengal, India', *Global Health Action*, 7(1): 21923. <https://doi.org/10.3402/gha.v7.21923>; accessed on 9 June 2019.
- Snell, Darryn and Peter Fairbrother. 2011. 'Toward a Theory of Union Environmental Politics: Unions and Climate Action in Australia', *Labor Studies Journal*, 36(1): 83–103. Available at <https://doi.org/10.1177/0160449X10392526>; accessed on 9 June 2019.

- Somanathan, E., R. Somanathan, A. Sudarshan, and M. Tewari. 2017. 'The Impact of Temperature on Productivity and Labor Supply: Evidence from Indian Manufacturing', Working Paper, EPIC-India. Available at <https://epic.uchicago.in/publication/impact-temperature-productivity-labor-supply-evidence-indian-manufacturing/>; accessed on 9 June 2019.
- Stavis, Dimitris and Romain Felli. 2015. 'Global Labour Unions and Just Transition to a Green Economy', *International Environmental Agreements: Politics, Law and Economics*, 15(1): 29–43. Available at <https://doi.org/10.1007/s10784-014-9266-1>; accessed on 9 June 2019.
- Sweeney, Sean. 2012. 'Resist, Reclaim, Restructure: Unions and the Struggle for Energy Democracy', Discussion document prepared for global union roundtable, 'Energy Emergency: Developing Trade Union Strategies for a Global Transition', 10–12 October.
- Sweeney, Sean and John Treat. 2018. *Trade Unions and Just Transition*. New York City, USA: Trade Unions for Energy Democracy.
- Temper, Leah, Mariana Walter, Iokiñe Rodriguez, Ashish Kothari, and Ethemcan Turhan. 2018. 'A Perspective on Radical Transformations to Sustainability: Resistances, Movements and Alternatives', *Sustainability Science*, 13(3): 747–64. Available at <https://doi.org/10.1007/s11625-018-0543-8>; accessed on 9 June 2019.
- Tran, Kathy, Gulrez Azhar, Rajesh Nair, Kim Knowlton, Anjali Jaiswal, Perry Sheffield, Dileep Mavalankar, et al. 2013. 'A Cross-Sectional, Randomized Cluster Sample Survey of Household Vulnerability to Extreme Heat among Slum Dwellers in Ahmedabad, India', *International Journal of Environmental Research and Public Health*, 10(6): 2515–43. Available at <https://doi.org/10.3390/ijerph10062515>; accessed on 9 June 2019.
- United Nations Framework Convention on Climate Change (UNFCCC). 2016. 'Adoption of the Paris Agreement Decision', 1/CP.21, FCCC/CP/2015/10/Add 1, p. 2, Annex: Paris Agreement.

Looking Out, Looking In

The Shifting Discourse on Climate Change in the Indian Print Media

Anu Jogesh

The Intergovernmental Panel on Climate Change (IPCC) released its special report on *Global Warming of 1.5°C*, in October 2018, presenting dire predictions on the time available for countries to act to prevent runaway climate change (IPCC 2018: 1–26). The findings of the report, quite unexpectedly, appeared on the front page of four Indian English dailies within the first two days of its release. This was apart from 12 other news articles during the same period.

Climate change reportage is now recognized as a small but staple fixture in the Indian print media, occasionally prone to spikes in coverage—much like the 1.5°C report. In the 10 years that the Centre for Policy Research (CPR) has been collating and disseminating its climate news briefs, at least three to five stories pertaining to climate change are quarried every day from newspapers screened online. From all anecdotal accounts, days with no published articles on climate change have become increasingly uncommon. The trend

denotes a gradual recognition of the topic as a domestic imperative among governments, scientists, businesses, and other stakeholders. The nature of the coverage in the last decade has also shifted. This chapter investigates these developments.

The chapter analyses how climate change has been reported by the English print media in India between 2010 and 2017. The period of analysis is notable because of key political, scientific, and policy-based outcomes that occurred during this period, namely, the Conference of the Parties (COP) in Paris in 2015; the release of IPCC's *Fifth Assessment Report* between 2013 and 2014; the Trump administration in the United States (US) announcing drastic changes in domestic and international climate policies in 2017; and significantly, the Indian government's endeavours (under both ruling parties) at steering national and sub-national policies and actions over eight years.

The chapter traces how the discourse has evolved around these events, from the perspective of the dominant themes covered, the narratives highlighted, and the stakeholders driving the debate. The aim of the chapter is to both qualitatively and quantitatively capture the shifting institutional landscape of climate change through the lens of the Indian print media.

As the title of the chapter suggests, the analysis reveals a shift in the underlying frequency and substance of the articles in the current study, from a position of 'looking out'—in framing climate action from the perspective of international developments—to an equal focus towards 'looking in' at domestic priorities and efforts as a means to define and shape climate action in India.

The print media is an important source for tracking India's climate debate. India has a thriving newspaper industry: in 2017, over 385 million Indians read a newspaper or periodical at some point in a month—a 40 per cent increase since 2014 (Media Research Users Council 2017). While most of the readership is driven by the vernacular press—9 of the top 10 papers are in Hindi or a regional language (Sarma 2017)—English-language newspapers still garner a bulk of the print media advertising revenue and continue to have a sizable sway in shaping national policy and opinion (Rathore 2012). So, while climate change may be a relatively small portion of the overall coverage in the English-language press, it is an important barometer of the relevance of the topic in India's larger political, economic, and development thought.

The chapter first describes the methodology employed in selecting and analysing news stories, and then provides a brief literature review of climate change in the Indian media. Then, the key findings are summarized, organized around dominant themes, and analysed across these themes, such as climate scepticism, policies and politics, sub-national versus national coverage, mitigation versus adaptation coverage, and climate equity.

Methodology

The chapter is based on a media discourse analysis of climate news coverage (O’Keeffe 2011). A sample of 1,645 articles was selected from a database of over 16,000 climate articles compiled by the CPR between 2010 and 2017, from a daily online search of 15 mainstream, broadsheet English-language newspapers in India (see Box 18.1). The text of each article was analysed and coded based

Box 18.1 Key Methodological Considerations for the Media Discourse Analysis

Source of articles: CPR’s database of articles obtained daily through a multiple keyword search on Google news and on individual news sites of 15 English-language newspapers in India.

Newspapers examined: *The Times of India, Hindustan Times, The Indian Express, The Hindu, Mint, The Economic Times, Financial Express, The Hindu Business Line, Business Standard, Daily News & Analysis (DNA), The Asian Age, Deccan Herald, Deccan Chronicle, The New Indian Express, The Telegraph.*

Period selected: 2010–7.

Types of articles included in the analysis: News reports, editorials, opinion editorials (op-eds), and articles sourced from wire news agencies.

Sample selection for the analysis: All articles (from the CPR database) published on the 2nd, 9th, 16th, and 23rd of each month between 2010 and 2017. If no articles were found on the aforementioned dates, then the author proceeded to the next date.

Sample size: 1,645 articles.

Source: Author.

on a selection of themes. These themes drew on work done in earlier climate change and media papers (Billet 2010; Jogesh 2012; Mittal 2012; Painter and Ashe 2012), and also included new elements based on the current policy and institutional context of climate change in India (such as the division of adaptation and mitigation interventions or the frequency of sub-national policy actions). Finally, all the climate articles (in the CPR database) were plotted chronologically to highlight the frequency of the total coverage over time.

Literature Review

The analysis of media and climate change is now a dedicated area of scholarship across many countries. Studies on climate change in the Indian media are relatively few, but have increased in number since 2009 (Thaker et al. 2017). Specifically, a number of recent studies have included India as a case study in comparative analyses of media approaches in a cross-section of countries (Painter and Ashe 2012).

An early, highly cited paper by Billet (2010) analyses the coverage of climate news in four Indian papers between 2002 and 2007 and notes that the Indian print media frames climate change along the axis of risk and responsibility. The paper argues that developing countries like India feel most at risk but pin the responsibility for action on industrialized economies. Jogesh (2012) analysed nine newspapers between 2009 and 2010 and concluded that in the run-up to the COP in Copenhagen and after, the discourse on climate change had relatively broadened compared to the period analysed in the Billet paper. Jogesh implied that while news articles predominantly looked to the Global North for action on climate change, the conversation had since expanded to also include a narrative on emerging economies like India taking on supported action (conditional upon the availability of finance and technology). Similarly, Thaker (2017: 1) carried out a meta-analysis of climate change communication in India and noted that the discourse on climate change had shifted from ‘externalizing the problem ... to a more recent co-benefits approach to address the twin challenges of climate change and economic development.’

Several of the articles highlight the near-absence of voices advocating climate scepticism in the Indian media (Billet 2010; Jogesh 2012; Mittal 2012). Painter and Ashe (2012) compared news coverage in

six countries during the height of the ‘Climategate’¹ scandal in 2009 and found that India had the lowest percentage of sceptical voices compared to the US and the United Kingdom (UK).

Climate Change in the Indian Media: Key Findings

News Metrics

Frequency of articles over time

A summary graph of monthly counts of articles between September 2009 and December 2017, presented in Figure 18.1, indicates that climate change is now continuously present in the Indian media—the graph seldom drops below 50 articles a month. However, it also indicates that there are definite peaks and dips tied to key climate events.

The COP 15 in Copenhagen in December 2009 was unprecedented in terms of the extent of awareness and publicity it generated around climate change globally. Articles during this period overshadow the rest of the coverage, capturing not only events and interventions by the climate community but also a host of traditionally non-climate commentators, such as technocrats, trade economists, and celebrities. The second-highest spike in the graph, expectedly, appears during the COP in Paris in 2015 when the landmark Paris Agreement was agreed upon. There are a number of other peaks spread across the years, although they are perceptibly lower in frequency. For instance, in 2012, the European Union (EU) levied carbon taxes on the international aviation industry as part of its Emissions Trading Scheme. The move drew heavy criticism from virtually all non-EU nations, including India, and received sustained coverage in the Indian print media. In 2014, there was a spurt in stories during the COP in Lima, focusing on the contours of each nation’s Intended Nationally Determined Contribution (INDC) in the run-up to the Paris Agreement. The year 2017 is another distinct period as the US announced its withdrawal from the Paris Agreement, creating a significant buzz during the COP in Bonn. A

¹ In November 2009, sensitive emails were leaked from the University of East Anglia’s (UEA) Climate Research Unit server, resulting in a spurt of news questioning the credibility of research on climate science.

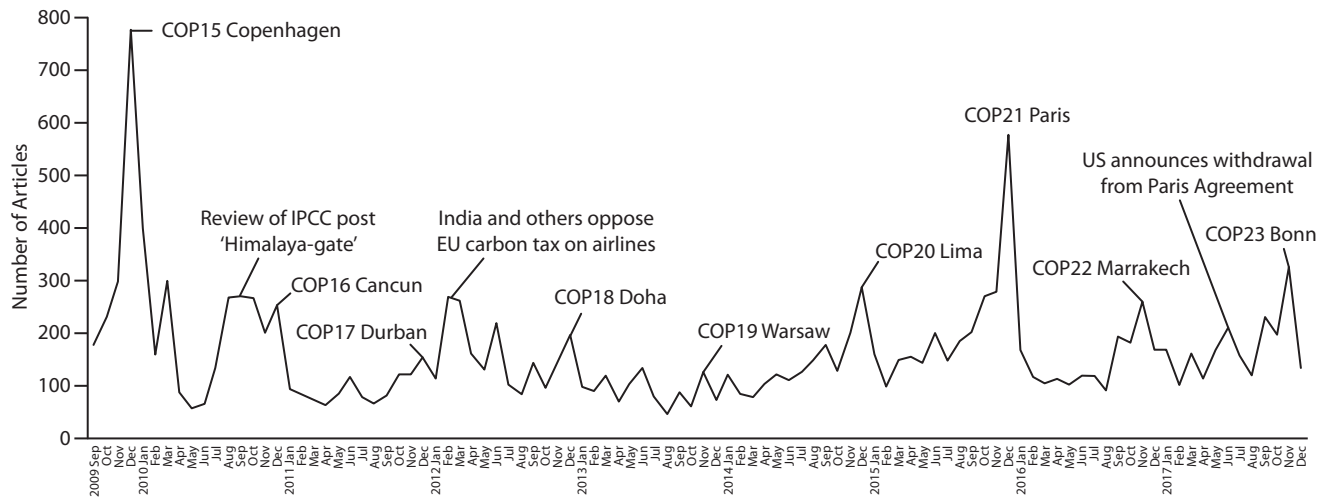


Figure 18.1 Frequency of All Articles in the Database between September 2010 and December 2017

Source: Author.

number of articles in 2014, 2015, and 2017 also focus on India's policies, especially its aggressive solar push domestically, its second carbon intensity target, and India's efforts internationally at setting up the International Solar Alliance.

Notably, if articles from the three months in 2009 are separated from the graph, the analysis registers a gradual increase in stories between 2010 and 2017. In many ways, the COP in 2009 was unprecedented in the quantum of interest it generated.

News initiating bodies

How climate news is generated—from the perspective of the experts, institutions, and events that drive the coverage—is a useful indicator of the key actors who influence the nature and direction of the climate change discourse.

The Indian government is one of the key drivers of news coverage in the current sample, representing a fourth of all news initiating bodies (see Figure 18.2). The sample includes not only the generically cited

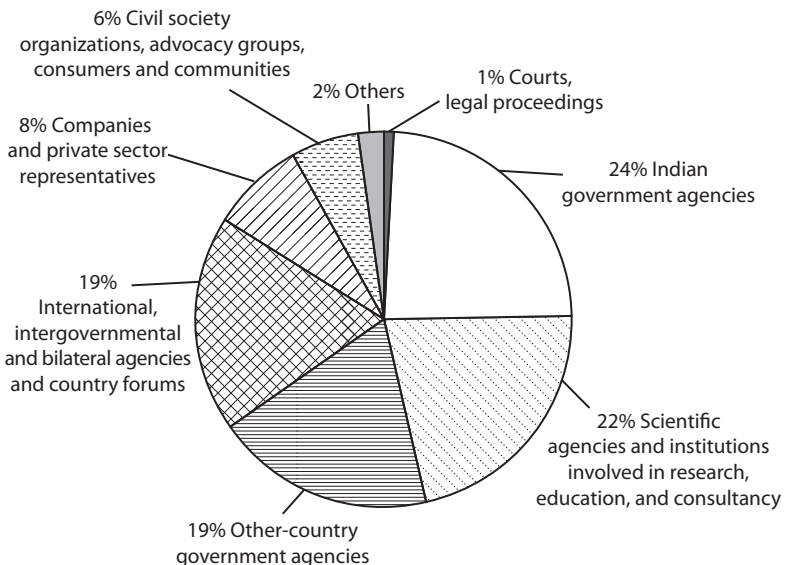


Figure 18.2 Types of News Initiating Bodies in the Sample

Source: Author.

'India', as in 'India Calls for a Deal for Pre-2020 Efforts to Tackle Climate Change' (Goswami 2015), but also state departments, urban local bodies, national and sub-national politicians, and public sector agencies like the Indian Railways. Scientific agencies and institutions involved in research, education, and consultancy come a very close second. This is a broad category including Indian and international scientists in government-funded agencies, such as the National Aeronautics and Space Administration (NASA) and India Meteorological Department, as well as experts in policy and research institutes.

International, intergovernmental and bilateral agencies and country groups, such as the United Nations (UN), IPCC, World Bank, and International Energy Agency (IEA), form the next most frequent category. Many of the stories driven by COP events (as well as outcomes of other forums, such as G20, Brazil, South Africa, India, and China [BASIC], and IPCC) come under this group. Not surprisingly, a bulk of the climate discourse is still driven by government agencies, scientific bodies, and international events—institutions easily accessed by (and available to) the mainstream media. Civil society organizations, advocacy groups, consumers, and vulnerable communities together form a miniscule 6 per cent of the total coverage.

Interestingly, one category that comes up post-2013 is the group pertaining to courts and legal proceedings. For instance, articles in 2013 reported on the first migrant from the island of Kiribati challenging his deportation from New Zealand in court calling himself a climate refugee (*Hindustan Times* 2013). In India, most of the reports refer to two court cases brought to the National Green Tribunal questioning the government on the progress of India's National Action Plan on Climate Change (NAPCC) and State Action Plans on Climate Change (SAPCCs) (*Business Standard* 2015; Perappadan 2016). While this is the smallest category in the sample, it is indicative of the nascent role that domestic and international courts are beginning to play in arbitrating on climate change.

Dominant Themes of News Articles

Climate change is a cross-cutting issue and five dominant themes emerge through an inductive analysis of the articles. These together

constitute the overarching focus areas of climate news coverage in India, namely, policies, politics, climate science and impacts, business, and a broader category encompassing stories on society, advocacy, and culture. To distinguish between local and global drivers, these themes have been further categorized into Indian and internationally driven stories (see Figure 18.3).

Stories on climate policies dominate the news coverage, with articles on politics as well as science and impacts following close behind. While the variation in frequency between the first three categories is relatively small (and likely prone to shifts in a sample-led analysis), there are four key trends of note. First, news coverage is not predominantly driven by the politics of climate change—of which global negotiations are a large part. There is equal emphasis on domestic policies and interventions. Second, the split between Indian and internationally led stories across politics and policies is almost even. This trend is a departure from articles examined before and after the COP in Copenhagen in 2009, where internationally driven stories were significantly more in number than stories on Indian politics and policies (Jogesh 2012). Third, there is a corresponding focus on climate science and impacts in the news coverage. A diverse range of

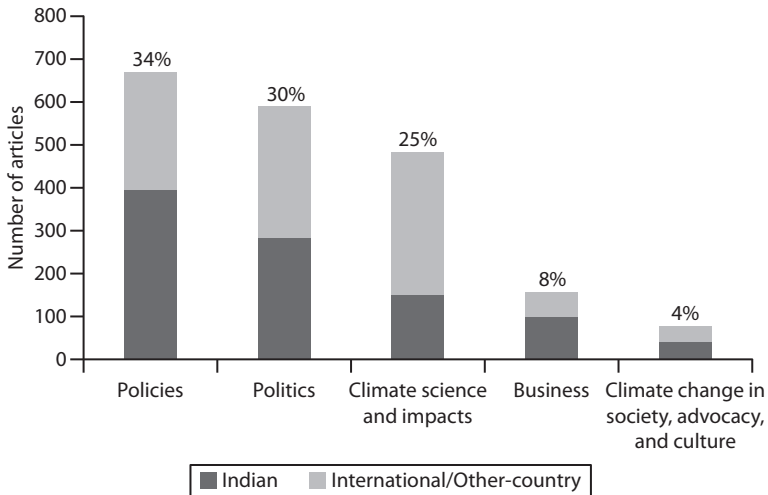


Figure 18.3 Dominant Themes in News Sample between 2010 and 2017
Source: Author.

climate impacts—geophysical, ecological, socio-economic, and even cultural—appear in the news, backed by research and science. For instance, a piece in *Business Standard* (2014) notes: ‘global warming could significantly increase the price of a pint of beer—and even change the taste too.’ The discourse is in line with an earlier paper which notes that the Indian press projects climate change as a ‘socio-environmental issue, rather than reducing it to a distant scientific process’ (Billet 2010: 7).

There is also a small but growing trend of climate impact stories that are simply observed and anecdotal in nature. Extreme weather events, such as the floods in Chennai in 2015, floods in Mumbai in 2017, and Hurricane Harvey in the US, all prompted questions on the potential linkages of such events to climate change in the news.

Stories on climate change in business are far fewer in number and include interventions of individual companies (like the Tata Group, Tamil Nadu Cements, and Vodafone India), as well as global markets and industry-based news, such as the business uncertainty over UN’s Clean Development Mechanism post-2013 or the US coal companies’ reaction to Trump’s intention to exit the Paris Agreement.

Finally, while articles on climate change in society, advocacy, and culture form the smallest percentage of the overall news sample, they signal a broadening of the climate change conversation, albeit in a small way, from being the mainstay of science and policy to also becoming a subject of interest in sports, literature, art, and advocacy through entertainment. For example, an article in 2016 is about actor Leonardo DiCaprio’s views on Pope Francis’ stance on climate change (*DNA* 2016).

The analysis overall points at a gradual but strategic shift, from treating climate change solely as a global collective action problem—to be resolved through negotiations and apportioning of carbon budget between countries—to an equal focus on addressing climate change through local action. While the former continues to be a dominant approach (climate summits and negotiations are still a big draw for governments in terms of international diplomacy and signalling), domestic climate policies and interventions have gained in momentum and scale over the last decade. There is also a parallel recognition of the seriousness of climate impacts in both industrialized and developing countries.

Cross-Thematic Analysis

Climate scepticism

The foreword to IPCC's 2014 synthesis report states that: 'The IPCC is now 95 percent certain that humans are the main cause of current global warming' (IPCC 2014a: v). Yet, climate scepticism is prevalent in the media of industrialized economies, such as the US, UK, and Australia (Painter and Ashe 2012). A number of studies on climate change have reported on the media's tendency to create 'false equivalence', where climate scientists are routinely pitted against climate deniers for the sake of a balanced story (Grimes 2016). In contrast, climate scepticism is conspicuous by its absence in the Indian press. In fact, a number of studies on climate change have pointed at the negligible presence of climate scepticism in the Indian media (Billet 2010; Jogesh 2012; Painter and Ashe 2012).

Confirming this trend, only 0.5 per cent of the articles in the current sample present sceptical views² and 2.6 per cent of the articles (close to five times the number) explicitly discredit climate scepticism (see Figure 18.4). Among the small group of articles presenting sceptical views, 2010 and 2017 were the two years when the proportion of overtly sceptical articles were at their highest. A number of climate-linked controversies³ were reported by the Indian and international print media in 2010, and these fuelled the sceptical views that appeared in the news. For instance, a 2010 article refers to the former director of the University of East Anglia's (UEA) Climatic Research Unit stating, 'Jones also conceded the possibility that the world was warmer in medieval times than now—suggesting global warming may not be a man-made phenomenon' (*Hindustan Times* 2010).

Articles in 2017 almost entirely focused on the views of US President Donald Trump, as well as his nominees and appointees to key offices, and their history of taking an openly sceptical stance on

² Articles that merely referred to someone as a climate sceptic and did not elaborate upon their views were not counted in the sample, for instance, 'Donald Trump picks climate change sceptic Scott Pruitt to helm EPA'.

³ As mentioned earlier, in November 2009, controversial emails were leaked from UEA's Climate Research Unit server; and in January 2010, errors in the IPCC *Fourth Assessment Report* on the rate of retreat of Himalayan glaciers were discovered and publicized.

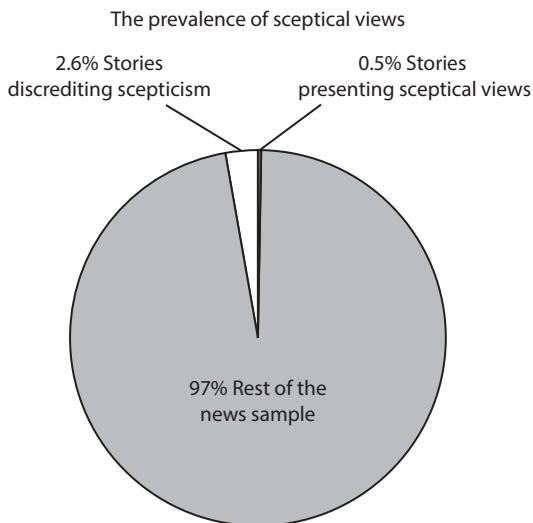


Figure 18.4 Articles in the News Sample that Refer to Climate Scepticism

Source: Author.

climate change. Most of the stories in 2017 discredited their stance (either through the overall editorial slant of the piece or through other quotes), but a few stories did not; and these formed the small group of articles with sceptical views in 2017. For instance, a 2017 article noted, ‘Kathleen Hartnett White testified before a Senate committee weighing her confirmation as chair of the Council on Environmental Quality at the White House. White, who is from Texas, reiterated her view that carbon dioxide is a “plant nutrient,” not a pollutant’ (*Financial Express* 2017).

The near-absence of sceptical voices in the Indian print media may be due to the lack of an organized conversation advocating climate scepticism in India. While there are anecdotal accounts of individual sceptics among local universities, advocacy groups, and businesses, their stories get far less play in the press. When there is a larger news development, such as IPCC’s error on the rate of glacier melt in the Himalayas, these local sceptical voices (and those of recognized sceptics abroad) are featured. For instance, following the IPCC glacier error, a columnist in the *Financial Express*, who otherwise writes on the investment sector, wrote a sceptical piece stressing, ‘The Earth

started warming long before cars and power stations were invented. There's little correlation with CO₂ levels' (Kewalramani 2010).

Policies and politics

Stories on policies and politics form a substantive portion of news in the current sample, notably encompassing over 60 per cent of the total coverage. The following section therefore is a more granular analysis of politics and policy-based stories in the Indian print media. This dominant theme is further categorized into five sub-themes: policies in India and internationally; politics around the negotiations in India and globally; and internal politics on climate change in India.

Stories on Indian policies constitute the highest proportion of all articles both in absolute terms and as a percentage of all politics and policy-based stories in the news sample (see Figure 18.5). This

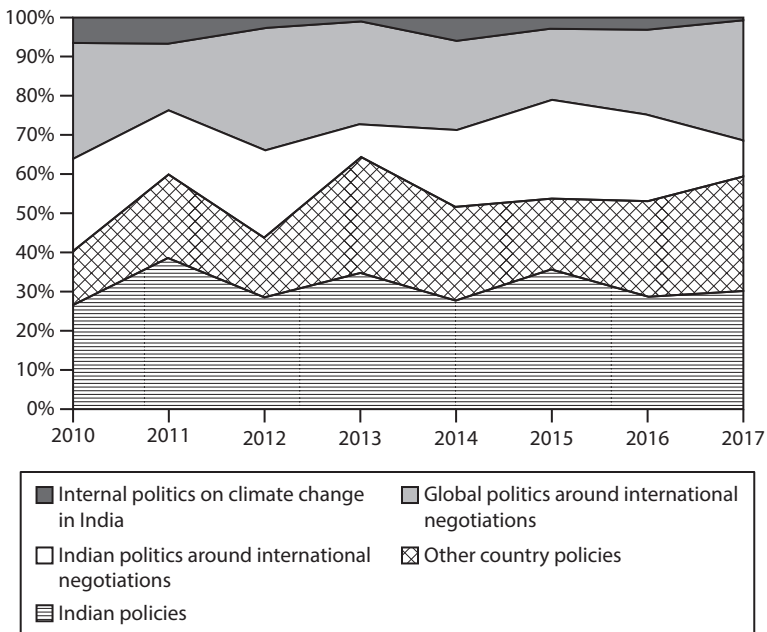


Figure 18.5 Year-Wise Analysis of Articles on Indian and International Policies and Politics

Source: Author.

trend mirrors key developments in the Indian climate policy landscape over the past decade. For instance, in 2009, the Government of India released the NAPCC and thereafter, states were asked to prepare climate action plans (MoEF 2008, 2009). What followed was a spate of (sustained, although selective) activity at the national and sub-national level, encompassing research, plan development, policy regulation, and donor-driven pilot programmes. In parallel, low-carbon, climate-resilience, and disaster management efforts were carried out by government and non-government agencies. Many of these initiatives are reflected in the news sample.

‘Global politics around negotiations and international climate action’ forms the next highest category in proportion to other stories under this overarching theme. Year-wise, there are three distinct spikes in the percentage of news coverage on global politics—in 2010, 2012, and 2017. In 2010, much newsprint was dedicated to how countries would take the ‘disappointing’ Copenhagen Accord forward (*Economic Times* 2010). In 2012, a bulk of the focus was on the EU’s largely unpopular carbon tax on the international aviation industry. For instance, a 2012 article notes, ‘With European Union (EU) facing global flak over the imposition of a green tax on all aircraft flying in its skies, world airlines’ body IATA has warned European airlines of “retaliatory action” by non-EU nations if a global solution was not arrived at soon’ (*Financial Express* 2012). Finally, 2017 was the year when countries anxiously debated the implications of the US’ exit from the Paris Agreement.

In a seemingly counter-intuitive trend, stories on global politics decline in proportion in 2015, the year of the Paris Agreement. This is because the degree of reportage in the run-up to the Paris COP is better reflected in the category ‘Indian politics around international negotiations and climate action’. This bridge category captures stories on India’s role in international negotiations as well as India’s communication with other countries and country forums on their respective submissions. For instance, an op-ed piece by former special envoy on climate change, Shyam Saran, in *Hindustan Times* was headlined, ‘Red Lines on a Green Field: What India Should Do at Climate Talks’ (Saran 2015).

News stories under ‘global and other-country policies’ do not follow any definitive trend, dependent as they are on peaks and dips in policy developments and proposals across other nations. However,

2017 was a notable year because the coverage was almost entirely focused on institutional shifts in climate, energy, and environmental decision making in the US under the Trump administration.

Internal politics on climate change in India forms the smallest proportion of all articles under the overarching theme. It is an intermediate category inductively selected to reflect domestic political commentary—often public divisiveness—of India's negotiating strategy and submissions. This category is reflective of differing views within the country (among political parties, advocacy groups, even some reporters) on India's 'red lines' in terms of its give and take at the negotiations (Saran 2015). This was a larger category in 2009 when there were openly differing positions between the members of India's negotiating team at Copenhagen (Jogesh 2012). For instance, a 2009 article notes, 'Jairam Ramesh, Minister of State (independent charge), Environment and Forests, on Monday came under severe criticism for a recent proposal that, the Opposition said, amounted to a total shift in India's stand on climate change at the coming meeting at Copenhagen' (*Hindu* 2010). While such instances of open criticism on India's climate politics have notably dipped in the current sample, they seem to manifest (albeit in small numbers) during key COP years. For instance, a column in the *Mint* in 2015 notes: 'The finance ministry is once again the locus ... of another, potentially seriously embarrassing, leak: a private memorandum from chief economic adviser Arvind Subramanian ... arguing the case for a major overhaul in India's negotiating position in the lead-up to the global climate policy summit set for Paris later this year' (Dehejia 2015)

There is an overall rise in the frequency of politics and policy-based articles between 2010 and 2017. However, 2013 was an exception, and the dip in politics and policy coverage was offset in the overall sample by a corresponding increase in reports on climate science and impacts. Many newspapers wrote on the findings of IPCC's *Fifth Assessment Report*, particularly Working Group I on the physical science basis, released in 2013.

National and sub-national action

Stories focused on domestic policies, as noted in the previous section, constitute a diverse array of initiatives and suggestions for action at the national, state, and city level. National-level policies form the

highest share of stories in this category, with state and city-based stories split equally (see Figure 18.6). A small percentage of national and sub-national articles also refer specifically to the NAPCC (or specific national missions under it), as well as SAPCCs.

Most of the stories that mention the NAPCC refer to the National Solar Mission; not surprisingly, since it has been one of the most fleshed-out missions (along with the mission on enhanced energy efficiency) in terms of policy regulation. These articles capture impacts on solar investments, energy prices, trade modalities, and general growth in the renewable industry in India. For instance, a 2011 article in the *Economic Times* is titled, 'Govt Sanctions Rs. 486 Crore Fund to Help Solar Power Producers', referring to the first phase of the National Solar Mission (Desai 2011).

In the last eight years, every state and union territory has developed a state climate plan or SAPCC, but as Figure 18.6 indicates, the documentation of the process in mainstream media has been relatively scant. There are likely two reasons for this: first, the awareness of state-level climate action in the mainstream media has been relatively low. Past studies on SAPCCs have indicated the limited

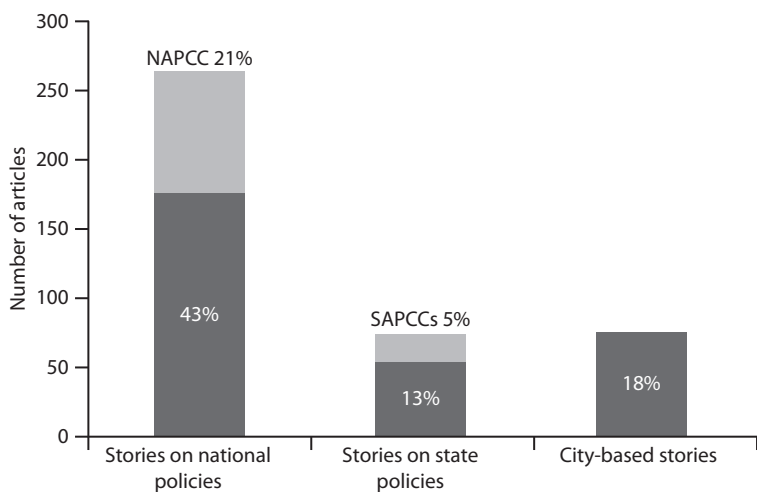


Figure 18.6 Stories in the Sample Referring to National and Sub-national Policies in India

Source: Author.

attention that plans garnered outside the circle of core national and sub-national stakeholders that were involved in the process (Dubash and Jogesh 2014). Second, these stories likely received better coverage in the local vernacular press. This study is limited by its focus on the English-language print media.

Mitigation and adaptation of climate action

There is widespread agreement in the global community that climate change needs to be tackled through both mitigation and adaptation action; interventions need to ideally balance a combination of activities designed to reduce greenhouse gas emissions and also manage risks from extreme and slow onset climate events (ClimaEast 2018). This recognition has been relatively recent in terms of its formalization in international climate talks and as a result, climate pledges continue to focus disproportionately on mitigation actions (IPCC 2014b: 1–30).

Domestically, too, there has been a greater emphasis—by way of political attention and regulation—on energy efficiency and renewable energy policies. News stories in the sample seem to reflect this difference. In fact, half of all articles in the sample, and a significant 74 per cent of all articles referring specifically to mitigation or adaptation focus on current domestic and international efforts towards mitigation action, or suggest the need for it (see Figure 18.7).

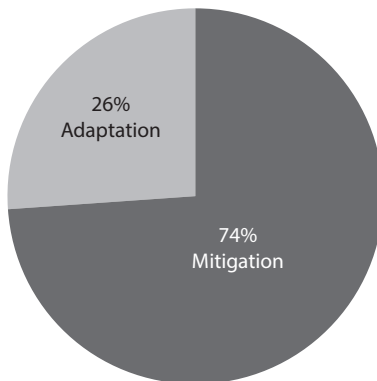


Figure 18.7 Articles on Mitigation and Adaptation in the News Sample

Source: Author.

Stories capturing adaptation efforts or suggestions focused on enabling adaptation are far fewer in number. Adaptation-linked articles increased in proportion post-2013, signalling a nascent but growing recognition of the seriousness of managing current and future climate risks. This is in line with some of the adaptation articles which highlight climate impacts and also offer solutions to manage it. There is also a spurt in stories in 2014 referring to both mitigation and adaption, linked to a growing narrative that countries' INDCs include both adaptation and mitigation components as part of the Paris Agreement.

Climate equity justice and burden sharing

Climate change has historically been a deeply divisive issue, particularly when it comes to questions of equity, responsibility, and burden sharing (see Chapter 6 in this volume). This section focuses on narratives linked to these issues. News articles in the sample have been coded inductively to arrive at five key frames that encapsulate underlying assumptions in the proposals and pledges put forward by different countries and economic blocs (see Figure 18.8).

The most dominant and pervasive frame in this category (a cumulative 34 per cent) is the need for industrialized economies to facilitate finance and technology transfer as part of their climate efforts. This frame subsumes narratives such as asking industrialized economies for more finance, focusing on the modalities of technology transfer, how funding mechanisms (like the Green Climate fund) are evolving, and whether available funds are adequate. The offer of voluntary action, conditional upon financial and technological support, is one area where developing countries (independent of their group affiliation in the negotiations) agree upon. For instance, a piece in 2013 notes, 'The BASIC Group ... has reiterated the need for a roadmap to raise funds for green climate and urged the developed countries to contribute their share to the funding of US\$30 billion that they have already agreed' (*Business Standard* 2013b).

The next dominant frame (a cumulative 29 per cent) revolves around the idea that since industrialized economies are historically responsible, negotiations and pledges must follow the principles enshrined in the United Nations Framework Convention on

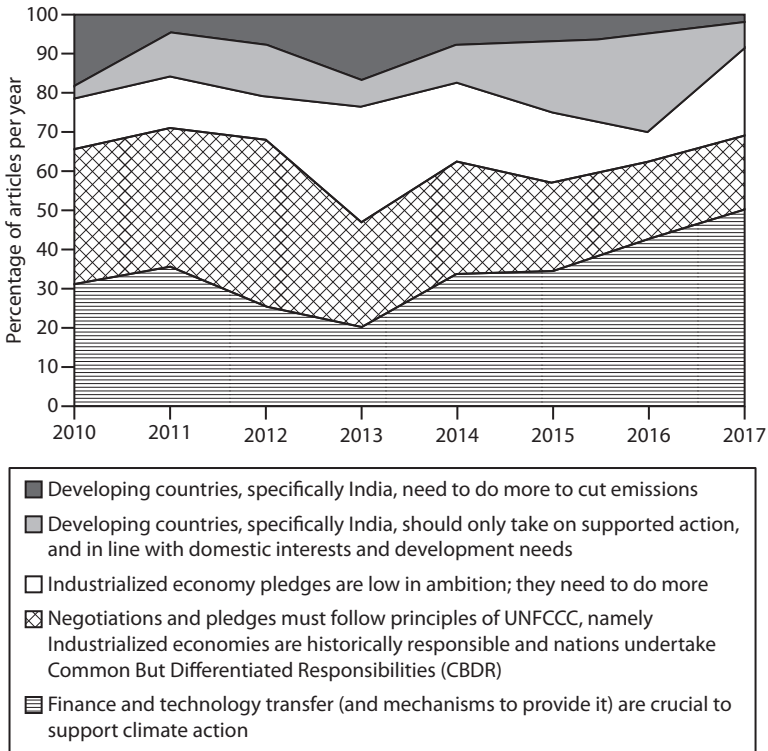


Figure 18.8 Positions on Climate Equity and Burden Sharing in the News Sample

Source: Author.

Climate Change (UNFCCC), specifically on common but differentiated responsibilities (CBDR). This sub-category also includes calls for the extension of Kyoto Protocol and the need to maintain the ‘firewall’ between Annex and non-Annex 1 countries. There is a steady decline in this frame post 2012. With countries converging around the idea of INDCs, the explicit differentiation between developing and industrialized economies seems to have blurred (much to the chagrin of some Indian stakeholders and commentators). For instance, a 2014 piece in the *Business Standard* explains:

The old rich want the differentiation between the past polluters and the current and future ones to go. ... At the 2013 conference

of parties in Warsaw it was agreed that ‘all’ countries would submit their Intended Nationally Determined Contributions (INDC) by early 2015. In other words, now there is no agreement that specifies the targets for each country based on their past contributions. (Narain 2014)

The few stories that used this frame in 2014 and 2015 were focused on stressing that CBDR be retained in the Paris Agreement.

The third dominant frame (a cumulative 17 per cent) is that industrialized economy pledges are low in ambition and they need to do more. The theme is aligned to positions that industrialized nations are historically responsible and are required to provide financial and technical support. While most of the articles allude to industrialized countries as a whole, some stories refer specifically to countries within the EU, and often the US. A bulk of the articles in 2017, for instance, point at America’s decision to withdraw from the Paris Agreement, and how the move undermines the collective ambition of industrialized economies. An op-ed in *Hindustan Times* notes, ‘As the US didn’t want to take full responsibility and do its part to solve the climate problem, it pushed for an agreement that was a “common minimum denominator”. ... Still the US walked away from the agreement terming it as “unfair”’ (Bhushan 2017).

The smallest proportion of articles in the category include the frame that developing countries, specifically India, need to do more to cut emissions. Close to a third of these stories appeared in 2010.⁴ This trend declines in proportion as the years progress, and is matched by a corresponding rise in stories that state that emerging economies, specifically India, can do more but in line with domestic interests and development needs.

This narrative of emerging economies taking on supported action, in line with domestic development and economic interests, is a relatively recent one; it sits alongside long-standing frames (captured in earlier articles) requiring industrialized economies to take a greater

⁴ In the run-up to the COP in Cancun, many articles focused on India being ‘under pressure’ by industrialized economies (and other BASIC members) to take on legally binding emission cuts (*Business Standard* 2013a).

lead in burden sharing as they are historically responsible (Billet 2010; Jogesh 2012).

Analysing news articles on climate change over time is like plotting a map of key climate events; the coverage together provides a snapshot of the climate story, capturing policies, institutions, actors, and events (both principal and supporting) that have shaped the climate narrative thus far.

To document the shifting discourse on climate change in India, the current study focuses on climate change reportage in the English print media between 2010 and 2017. The study finds a gradual evolution in the discourse on climate change in three areas. First, there is a greater focus on domestic policies and interventions, driven by a spate of domestic action over the last decade. Second, dominant actors no longer press on a purely top-down solution; news and views have, more recently, converged around the idea of domestic self-determination, mirroring the approach encapsulated in the Paris Agreement. Third, while the conversation on fixing responsibility for ambitious action on industrialized economies is still strong, there is now a parallel discourse advocating action by developing nations, in line with their local development priorities. This view is partially influenced by a greater recognition of the risk posed by climate impacts.

In the changing frames in equity and burden sharing, the near-equal division of policies and politics in the sample, and the predominance of an India-led discourse, there seems to be—as noted in the beginning of the chapter—a shift in focus towards ‘looking in’, rather than ‘looking out’, in arriving at a shared consensus on climate change.

References

- Bhushan, Chandra. 2017. ‘Why US Exit from Paris Climate Deal Is a Tight Slap for the Rest of the World’, *Hindustan Times*, 3 June. Available at <https://www.hindustantimes.com/opinion/why-us-exit-from-paris-climate-deal-is-a-tight-slap-for-the-rest-of-the-world/story-qwZZk-1paeaKOYUGqnwlt7L.html>; accessed on 3 August 2018.

- Billett, Simon. 2010. 'Dividing Climate Change: Global Warming in the Indian Mass Media', *Climatic Change*, 99(1–2): 1–16. Available at <https://doi.org/10.1007/s10584-009-9605-3>.
- Business Standard*. 2013a. 'India under Pressure at Cancun Climate Conference', 21 January 2013. Available at https://www.business-standard.com/article/economy-policy/india-under-pressure-at-cancun-climate-conference-110120900129_1.html; accessed on 18 September 2017.
- . 2013b. 'Fund Us to Fight Climate Change, BASIC Nations Urge Richer Countries', 16 February. Available at http://www.business-standard.com/article/economy-policy/fund-us-to-fight-climate-change-basic-nations-urge-richer-countries-113021600546_1.html.
- . 2014. 'Global Warming to Hit Your Bubbly's Taste!', 17 April. Available at http://www.business-standard.com/article/news-ians/global-warming-to-hit-your-bubbly-s-taste-114041700444_1.html; accessed on 7 October 2017.
- . 2015. 'Climate Change Issue beyond NGT's Jurisdiction: MoEF'. 2 April. Available at http://www.business-standard.com/article/news-ians/global-warming-to-hit-your-bubbly-s-taste-114041700444_1.html.
- ClimaEast. 2018. 'Adaptation, Mitigation, Climate Finance and Technology'. Available at <http://www.climaeast.eu/unfccc-info/adaptation-mitigation-climate-finance-and-technology>, accessed on 14 May 2018.
- Dehejia, Vivek. 2015. 'Climate Games in New Delhi', *Livemint*, 16 August. Available at <https://www.livemint.com/Opinion/pvMVivDclWbr9gvdvj6gwO/Climate-games-in-New-Delhi.html>; accessed on 10 November 2018.
- Desai, Vijay. 2011. 'Govt Sanctions Rs. 486 Crore Fund to Help Solar Power Producers', *The Economic Times*, 2 June. Available at <https://economictimes.indiatimes.com/industry/energy/power/govt-sanctions-rs-486-crore-fund-to-help-solar-power-producers/articleshow/8697690.cms>; accessed on 1 April 2018.
- Daily News & Analysis (DNA)*. 2016. 'Pope's Stance on Climate Change is Revolutionary: Leonardo DiCaprio', 2 February. Available at <https://www.dnaindia.com/entertainment/report-pope-s-stance-on-climate-change-is-revolutionary-leonardo-dicaprio-2173043>; accessed on 11 September 2018.
- Dubash, Navroz K. and Anu Jogesh. 2014. 'From Margins to Mainstream? Climate Change Planning in India as a 'Door Opener' to a Sustainable Future', Climate Initiative, Research Report, Centre for Policy Research (CPR), New Delhi.
- Economic Times, The*. 2010. 'Copenhagen Accord Disappointing: PM', 4 January. Available at <https://economictimes.indiatimes.com/news/>

- politics-and-nation/copenhagen-accord-disappointing-pm/article-show/5408315.cms; accessed on 6 March 2018.
- Financial Express*. 2012. 'EU Green Tax: Global Airlines Warn of Retaliatory Action', 9 February, available at <https://www.financialexpress.com/archive/eu-green-tax-global-airlines-warn-of-retaliatory-action/909659/>; accessed on 5 May 2018.
- . 2017. 'Donald Trump Environment Nominees Pressed on Federal Climate Report', 9 November. Available at <https://www.financialexpress.com/world-news/donald-trump-environment-nominees-pressed-on-federal-climate-report/925355/>; accessed on 10 October 2017.
- Goswami, Urmi. 2015. 'India Calls for a Deal for Pre-2020 Efforts to Tackle Climate Change', *The Economic Times*, 30 March. Available at <https://economictimes.indiatimes.com/news/politics-and-nation/india-calls-for-a-deal-for-pre-2020-efforts-to-tackle-climate-change/article-show/46740791.cms>; accessed on 10 November 2018.
- Grimes, David Robert. 2016. 'Impartial Journalism Is Laudable. But False Balance Is Dangerous', *The Guardian*, 8 November. Available at <https://www.theguardian.com/science/blog/2016/nov/08/impartial-journalism-is-laudable-but-false-balance-is-dangerous>; accessed on 12 September 2018.
- Hindu*, *The*. 2010. 'Jairam Ramesh's Plan Comes under Attack', 5 March. Available at <https://www.thehindu.com/todays-paper/tp-national/Jairam-Rameshs-plan-comes-under-attack/article16498386.ece>; accessed on 4 March 2018.
- Hindustan Times*. 2010. 'Key Climate Change Scientist Says He Can't Find Data', 16 February. Available at <https://www.hindustantimes.com/world/key-climate-change-scientist-says-he-can-t-find-data/story-AvlQ1iCoRn6TjADCpFZG2I.html>; accessed on 8 March 2018.
- . 2013. 'Pacific Man Bids to Become First Climate Change Refugee'. 17 October. Available at <https://www.hindustantimes.com/world/pacific-man-bids-to-become-first-climate-change-refugee/story-ENN9PVjhtPygwUA54bl1bP.html>.
- Intergovernmental Panel on Climate Change (IPCC). 2014a. 'Climate Change 2014: Synthesis Report', in R.K. Pachauri and L.A. Meyer (eds), *Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 1–151. Geneva, Switzerland: IPCC.
- . 2014b. 'Summary for Policymakers', in O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the*

- Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 1–30. Cambridge and New York: Cambridge University Press.
- . 2018. ‘Summary for Policymakers’, in V. Masson-Delmotte, P. Zhai, H.O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, et al. (eds), *Global Warming of 1.5°C*, pp. 1–32. Geneva: World Meteorological Organization.
- Jogesh, Anu. 2012. ‘A Change in Climate? Trends in Climate Change Reportage in the Indian Print Media,’ in Navroz K. Dubash (ed.), *Handbook of Climate Change and India: Development, Politics and Governance*, pp. 266–86. New York: Earthscan.
- Kewalramani, Sunil. 2010. ‘Our World Was Hotter 1,000 Years Ago’, *Financial Express*, 29 January. Available at <https://www.financialexpress.com/archive/our-world-was-hotter-1-000-years-ago/572665/>; accessed on 11 March 2018.
- Media Research Users Council. 2017. ‘IRS 2017: Key Trends’. Available at <http://mruc.net/uploads/posts/a27e6e912eedeab9ef944cc3315fba15.pdf>; accessed on 25 May 2018.
- Ministry of Environment and Forests (MoEF). 2008. ‘National Action Plan on Climate Change’, Government of India. Available at <http://www.moef.nic.in/downloads/home/Pg01-52.pdf>, accessed on 26 May 2018.
- . 2009. ‘State Action Plan on Climate Change’. Available at <http://www.moef.nic.in/ccd-sapcc>; accessed 25 May 2018.
- Mittal, Radhika. 2012. ‘Climate Change Coverage in Indian Print Media: A Discourse Analysis’, *The International Journal of Climate Change: Impacts and Responses*, 3(2): 219–32.
- Narain, Sunita. 2014. ‘Sunita Narain: Be Proactive on Climate-Change Equity’, *Business Standard*, 10 November. Available at https://www.business-standard.com/article/opinion/sunita-narain-be-proactive-on-climate-change-equity-114110900831_1.html; accessed on 17 June 2018.
- O’Keeffe, Anna. 2011. ‘Media and Discourse Analysis’, in James Paul Gee and Michael Handford (eds), *The Routledge Handbook of Discourse Analysis*, pp. 441–54. London: Routledge.
- Painter, James and Teresa Ashe. 2012. ‘Cross-National Comparison of the Presence of Climate Scepticism in the Print Media in Six Countries, 2007–10’, *Environmental Research Letters*, 7(4): 1–8. Available at <http://doi.org/10.1088/1748-9326/7/4/044005>.
- Perappadan, Bindu Shajan. 2016. ‘NGT Notices to Delhi, MoEF’. *The Hindu*, 2 September. Available at <https://www.thehindu.com/todays-paper/tp-national/tp-newdelhi/NGT-notices-to-Delhi-MoEF/article14618744.ece>.

- Rathore, Sumantha. 2012. 'Print Special: A Report of the Indian Newspaper Industry', *Afaqs.com*, 27 August. Available at http://www.afaqs.com/news/story/38475_Print-Special-A-report-of-the-Indian-newspaper-industry.
- Saran, Shyam. 2015. 'Red Lines on a Green Field: What India Should Do at Climate Talks', *Hindustan Times*, 9 September. Available at <https://www.hindustantimes.com/analysis/red-lines-on-a-green-field-what-india-should-do-at-climate-talks/story-umXaSePhehoC7O4zS2rdVI.html>; accessed on 10 November 2018.
- Sarma, Dibyajyoti. 2017. '39% of Indians Read Newspapers: IRS 2017 Report', *PrintWeek India*, 19 January, available at <http://www.printweek.in/news/-indians-read-newspapers-irs-2017-report-27836>; accessed on 10 October 2017.
- Thaker, Jagadish. 2017. 'Climate Change Communication in India', *Oxford Research Encyclopedia of Climate Science*, pp. 1–18. Available at <https://doi.org/10.1093/acrefore/9780190228620.013.471>.
- Thaker, Jagadish, Xiaoquan Zhao, and Anthony Leiserowitz. 2017. 'Media Use and Public Perceptions of Global Warming in India', *Environmental Communication*, 11(3): 1–17. Available at <http://dx.doi.org/10.1080/17524032.2016.1269824>.

SECTION IV

POLICY

National Climate Policies and Institutions

Navroz K. Dubash and Shibani Ghosh

Over the last decade, India has seen a remarkable, if quiet, expansion in climate policy and institutions at national and sub-national levels. From being an exclusively diplomatic and foreign policy issue, government at various levels has experimented with internalizing climate change into national and sub-national policy.

In the mitigation area, this has, arguably, been driven by a growing sense that climate mitigation and domestic energy objectives need not necessarily be incompatible. In adaptation areas, growing awareness of impacts, backed by advances in climate science, has played an important role. In many ways, this advancement has happened iteratively, with the opening of small institutional spaces for consideration of climate change, followed by their occupation by enterprising bureaucrats and entrepreneurial civil society, leading to a further widening of institutional spaces.

Yet, this 'mainstreaming' of climate change into development should not be overstated. There is a multiplication of efforts and institutional spaces, as we discuss here, but the impacts on actual policy priorities and outcomes are far less visible. A novel policy

conversation was certainly initiated through efforts in national and state plans, but its results are far from clear.

The chapter traces the emergence of this domestic climate policy environment, starting with a series of policy actions spurred by the National Action Plan on Climate Change (NAPCC) and the deepening of these actions under the rubric of multiple objectives of climate and development. The next section discusses the articulation of these national efforts in India's Nationally Determined Contribution (NDC) submitted at the Paris Conference of the Parties (COP) in 2015. The following section focuses on parallel institutional developments, which often receive less attention than policy changes, but are an essential complement to them. On both policy and institutional developments, we focus on the national scale, with sub-national actions discussed in Chapters 20 and 21 of this volume. We conclude with reflections on the likely evolution of climate policymaking in India.

Emergence of National Climate Policymaking: The NAPCC

If a single moment marks the emergence of national climate policymaking in India, it is the release of the NAPCC. In an example of a 'two-level game' between international and national climate policy (Atteridge et al. 2012), the NAPCC was put in place as part of a drum roll of political attention leading up to the Copenhagen COP of 2009 (Atteridge et al. 2012; Dubash 2013). For example, climate change featured high on the agenda in meetings of high-profile political fora, such as the G8+5, stimulating national actions in response to global attention. Thus, China released its national plan in June 2007, enshrining a national emissions intensity target, a month before the annual G8+5 head of government meeting (Permanent Mission of the People's Republic of China to the UN 2007) and, not coincidentally, India released its NAPCC a year later, just before the 2008 meeting.

Subsequently, in 2009, India also issued its concrete international climate pledge, that the country's emissions intensity (emissions per unit of gross domestic product [GDP]) would decrease by 20–5 per cent from 2005 levels by the year 2020 (Lok Sabha 2009). However, in operational terms, this pledge did not appear to concretely drive

national policy, but instead served only as an international statement. The operational role was played by the mechanisms put in place through the NAPCC.

The NAPCC served three important functions while jump-starting India's national climate change framework: narrative, policy, and institutional. From a narrative point of view, the NAPCC squared the circle between an international negotiations stance that remained focused on differentiated responsibility—calling for the North to take the lead on climate mitigation—and an active domestic climate policy. This was accomplished by foregrounding the concept of 'co-benefits', defined as measures that 'promote ... development objectives while also yielding co-benefits for addressing climate change effectively' (Prime Minister's Council on Climate Change [PMCCC] 2008). This definition allowed India to proceed with the climate policy consistent with its development objectives, while avoiding dissonance with its international negotiating stance. From a policy and institutional perspective, the NAPCC set in motion several policymaking efforts organized around eight national 'missions', each backed by an institutional structure (discussed later in this chapter) that forged linkages with different line ministries.

The missions around which the NAPCC was organized covered a sprawling array of areas, covering both adaptation and mitigation. Some, such as the National Solar Mission (NSM), were tightly targeted on specific goals; in this case, the promotion of solar power. Others, such as the National Water Mission, effectively cut across the work of several ministries and other institutions related to water. Yet others, such as the National Mission on Sustainable Habitat and the National Mission for a 'Green India' on forests, were narrowly mapped to individual ministries—in these cases, the then Ministry of Urban Development and the then Ministry of Environment and Forests (MoEF). The diversity in scale and scope, and the sprawling structure of the missions, has led to critiques of the NAPCC as 'neither vision, nor plan' (*Economic & Political Weekly* 2008).

Given its importance, there are remarkably few studies available on the NAPCC (Byravan and Rajan 2012; Rattani 2018). One evaluation of the processes, rather than outcomes, of individual missions suggests that the approach across missions is a mixed bag: while some missions are strategic and focused, such as those on energy efficiency and solar promotion, many others are diffuse and encompass broad

swathes of areas, such as water, that have long defied development planning; and yet others are singular in their focus but broad in scope, such as the knowledge mission (Byravan and Rajan 2012). This makes it challenging to define goals in a manner that enables accountability. Moreover, while the co-benefits approach provides the overall framing, the specification of particular co-benefits that drive missions is absent, and missions tend to, therefore, have a wish list-like approach rather than providing strategic direction.

Despite these criticisms, the NAPCC missions have left their mark on climate policymaking in India. In some cases, notably the more focused missions such as those on solar promotion and energy efficiency, the policy landscape has been entirely transformed (Chapter 24 in this volume), with multiple new policy initiatives being developed and implemented through the missions. In other cases, as discussed further in this chapter, the appointment of nodal officers on climate change in line ministries has, at minimum, created new institutional spaces, which provide openings for policy linkages. However, to understand the implications of these spaces, and whether and how they have been used, requires further research.

Deepening Policymaking around Multiple Objectives

The co-benefits-based narrative construction of Indian climate policy has ensured that India's mitigation and adaptation efforts are multi-stranded. In the years since the NAPCC, a number of other policies have been put in place, sometimes emanating directly from NAPCC missions, but frequently motivated by non-climate issues. Whatever the provenance, energy-focused policy measures, in particular, take on a polyvalent character as measures that address a mix of objectives, such as energy security, energy access, air pollution, and climate change considerations.

So, both the NSM and the National Mission on Enhanced Energy Efficiency (NMEEE), originally set up as climate-focused missions, rested heavily on justifying their specific policy efforts as an energy security measure, which fit well with a co-benefits logic (Dubash 2011). The NSM could thus justify setting targets (originally 20 GW by 2022) for solar capacity addition, despite what were then substantially higher costs of solar power, as a step towards energy security;

selling this idea on the basis of climate mitigation alone would have likely been a political non-starter. While energy efficiency measures are cost-effective and therefore an easier sell, these too were marketed in policy documents as important contributors to energy security (The Energy and Resources Institute [TERI] 2009).

However, by no means did all energy-related efforts emanate from climate-focused institutional contexts, although even when not, they were often subsequently woven into India's larger climate mitigation story. A leading example is a clean energy cess on coal, established in 2010 at Rs 50 per tonne and subsequently increased annually to reach Rs 400 per tonne by 2016, with funds originally intended to support a transition to clean energy (Ministry of Finance [MoF] 2015, 2016; Ministry of Power [MoP] 2015). Another major example is the Ujjwala scheme to provide cooking fuel to all, which is motivated by energy access considerations, but will also have substantial consequences for indoor air pollution affecting human health and may provide mitigation gains too by displacing biomass burning (Press Information Bureau 2016).

A summary of several such far-reaching energy-related policy measures introduced in recent years is given in Table 19.1. The table suggests that, when understanding Indian climate mitigation, it is more appropriate to refer to policies that have the *effect* of climate mitigation, understanding that their institutional provenance may lie outside climate-focused institutions and that their objectives may be multiple. Indeed, a sensible way of understanding Indian climate policy, corresponding to the co-benefits narrative, is as a challenge of addressing multiple objectives simultaneously (Khosla et al. 2015).

In addition to national initiatives, there is a growing array of sub-national policy initiatives at both state and city levels. State-level climate policies (discussed in Chapters 20 and 21 in this volume) have been stimulated by a national mandate to prepare State Action Plans on Climate Change (SAPCCs), and have predominantly focused on adaptation actions. City-level climate action, by contrast (discussed in Chapter 25 in this volume), has been stimulated largely by global networks and donor organizations, and crosses both mitigation and adaptation efforts. At both state and city scales, these efforts are strongly shaped by efforts to link climate change to relevant local concerns, and imbue the co-benefits approach with meaningful substance.

Table 19.1 India's Policies Relevant to Mitigation and Energy

Year	Policy Area	Description
Energy Supply		
2015	Renewables	175 GW target of renewable energy capacity by 2022.*
2015	Domestic coal production	Increasing domestic coal production to 1 billion tonne (BT) from government and 0.5 BT from private firms by 2020.
2010	Coal cess	A coal cess to finance clean technology. Set in 2010 at Rs 50 per tonne, it increased to Rs 400 per tonne by 2016.*
Energy Efficiency and Clean Technology		
2012	Industrial energy efficiency	A 'Perform–Achieve–Trade' domestic energy efficiency credit-trading scheme for industries.*
2014, updated in 2015	Subsidized light-emitting diode (LED) bulbs	Aims at replacing 770 million inefficient bulbs by 2019.*
2013, updated in 2015	Liquefied petroleum gas (LPG) access	Targeted subsidies for LPG cylinders and gas connections to women from families 'Below Poverty Line'.*
2015	Light vehicles fuel standards	Leapfrogging from Euro IV to Euro VI standards by 2020.*
2013, updated in 2017	Electric mobility	Aims at penetration of hybrid and electric vehicles, targeting no new fossil fuel-powered vehicles by 2030.*
Infrastructure Transitions		
2006	Dedicated freight corridors	Enhancing rail freight infrastructure between major metros.*
2014, updated in 2017	Electricity for all	Aims at 24/7 supply to all households by 2019.*

2015	'Make in India'	Encouraging manufacturing in India.*
2015	Urban infrastructure	Smart Cities Mission,* basic services,* and Housing for All by 2020.
2007, updated in 2017	Commercial building energy standards	A voluntary Energy Conservation Building Code.

Note: * Mentioned in India's NDC.

Source: Authors' own assessment from websites of Government of India ministries.

Consolidating but Not Extending: India's 'Nationally Determined' Climate Contribution

As with the Copenhagen COP of 2009, the Paris COP of 2015 was instrumental in generating statements of climate action from India. However, while in 2008–9 India was starting with a substantially blank slate of climate policy, on this occasion, as suggested by Table 19.1 and the aforementioned discussion, India had an array of actions on both mitigation and adaptation, including at the state level. India's NDC submitted in the run-up to the Paris COP substantially drew on, consolidated, and projected the aggregate effect of this track record (Ministry of Environment, Forest and Climate Change [MoEFCC] 2015a).

The formulation of the NDC provided India an opportunity to enhance its institutional capacity to strategize on climate issues, particularly their linkages with developmental concerns. While there is little to indicate that the NDC has further contributed to enhancement and development of national climate policy, the process of its formation exhibited deliberate attempts at inter-ministerial coordination. The MoEFCC initiated intensive consultations in 2014 with various ministries, departments, and state governments, and inter-ministerial committees were constituted to develop sector-specific background material for India's submissions.¹ The ministry

¹ Interview with Dr S. Satapathy, former MoEFCC official, 5 October 2018.

also reached out to think tanks and research organizations for inputs on modelling studies.² On energy demand and projections, specific inputs were sought from the MoP; and the India Energy Security Scenarios (IESS) 2047, developed by the NITI Aayog, formed the basis of the projections in the NDC (NITI Aayog 2016)

The NDC itself includes several elements salient for an international audience, such as locating India's contribution to climate change in the global context by noting its low levels of energy consumption. It summarizes India's policy framework for climate action by highlighting the NAPCC and SAPCCs, but also interestingly lists a range of other legal and policy frameworks as relevant, such as the National Environment Policy and National Policy for Farmers, indicating that climate action is part and parcel of larger sustainable development efforts.

The bulk of the document is taken up by a sector-by-sector listing of ongoing missions, policies, and schemes that the government has undertaken in all climate-relevant areas, such as energy supply, demand, transportation, agriculture, livelihoods, disaster management, and so on. The breadth of action is impressive in its range, but, equally, this breadth provides little indication of whether and how the government distinguishes or sees the need to distinguish climate from more general sustainable development policy. In this sense, the NDC is a missed opportunity to more rigorously engage with and operationalize the co-benefits framework, and utilize the NDC as an opportunity to organize the array of actions set in place since the NAPCC (Dubash and Khosla 2015). Instead, it is less of a guide to shape and prioritize future action and more of a harvesting of past ones.

The substantive core of India's NDC is organized around three quantitative pledges that provide a basis to explore implications for the development of future domestic climate policy. The document also includes five other pledges, such as enhancing domestic capacity and improving adaptation, that are framed too generally to enable analysis against past action or ensure accountability for future action. Of the quantitative pledges, the first mirrors and updates India's earlier pre-Copenhagen pledge by stating that India's emissions intensity

² Interview with Ajay Raghava, MoEFCC official, 11 December 2017.

will reduce by 33–5 per cent from 2005 levels by 2030. In principle, such a pledge could provide a target to guide future domestic action. However, a compilation and analysis of recent modelling studies suggests that existing domestic policy actions, which have been enhanced in recent years (as shown in Table 19.1), collectively are likely to take India into compliance with this pledge (Dubash et al. 2018b). Thus, this pledge is mostly an international statement of intent that signals the likely aggregate effect of current action, rather than a guide to future action.

The second pledge calls for India to increase its share of non-fossil fuel-based electricity to 40 per cent of total capacity by 2030 (see Chapter 24 in this volume). This is a substantial expansion of non-fossil electricity, and would represent adding almost the entire current electricity capacity only in renewable energy terms (including hydro and nuclear power) in a scant 15 years. Yet, understanding whether this represents a new direction for India is complicated by another, prior domestic statement of intent to add 175 GW of wind, solar, and biomass renewable energy by the much earlier date of 2022 (Khosla and Dubash 2015). Interpreting the significance of the former in light of the latter is a challenge because they use different metrics: the NDC is in terms of share of capacity and includes all non-fossil fuel sources; and the domestic statement is in terms of capacity and is limited to modern renewables. However, it seems highly likely that if the domestic 2022 pledge is achieved, the NDC pledge on renewable energy capacity will be comfortably exceeded (Dubash and Khosla 2015).

A third quantitative pledge calls for creation of an additional carbon sink of 2.5–3 billion tonnes of carbon dioxide equivalent through enhanced forest cover. This is likely the most significant of the three, in that it represents a step beyond domestic policy, but is likely to face substantial implementation challenges (see Chapter 26 in this volume).

The NDC also makes it clear that the realization of these pledges is ‘contingent’ on an ambitious global agreement, including ‘means of implementation’, a term that refers to financial and other support. Moreover, it includes an explicit discussion on the climate finance required for the realization of the proposed actions. While a careful accounting could have provided a useful guide for future

policy development, the approach in the NDC is to simply provide summary numbers on required finance without citations or underlying reasoning. Indeed, the numbers on adaptation cost (US\$206 billion at 2014–15 prices) and mitigation cost (US\$834 billion at 2011 prices) sum up to less than the total projected cost of US\$2.5 trillion (at 2014–15 prices).

Collectively, this reading of India's NDC suggests that the document is guided more by harvesting and consolidating domestic action in a statement for the international negotiation process, than as a document to further guide policy development. In its function as an international statement, the document showcases what is a wide, albeit somewhat ad hoc, range of actions in both mitigation and adaptation arenas, with what appears to be the intent of signalling that India is indeed pulling its weight through substantial domestic engagement with climate policy. However, in being limited, with the possible exception of the forest pledge, to ongoing domestic actions rather than new actions, the NDC traces a middle-of-the-road trajectory, seeking to provide 'neither brake nor accelerator' to the international process (Dubash and Khosla 2015).

Development of India's Climate Institutions

Institutions and governance processes are key to defining, and constraining, climate policymaking and action. They are instrumental in setting the incentive structures for decision making and shaping the political context that influences the decision-making process (Somanathan et al. 2014). They are also sites for moulding bureaucratic and political thinking on new concepts, policy design, and objectives, and mechanisms to achieve these objectives. Therefore, understanding institutions dealing with climate change in India is a necessary complement to understanding India's climate policies (Dubash and Joseph 2016).

Evolution of institutions dealing with climate change in India may be studied in four distinct periods: pre-2007, 2007–9, 2010–mid-2014, and mid-2014 to present. Figure 19.1 (between pages 326 and 327) is an institutional chart that shows the growth of institutions involved in climate change in India over the aforementioned four time periods.

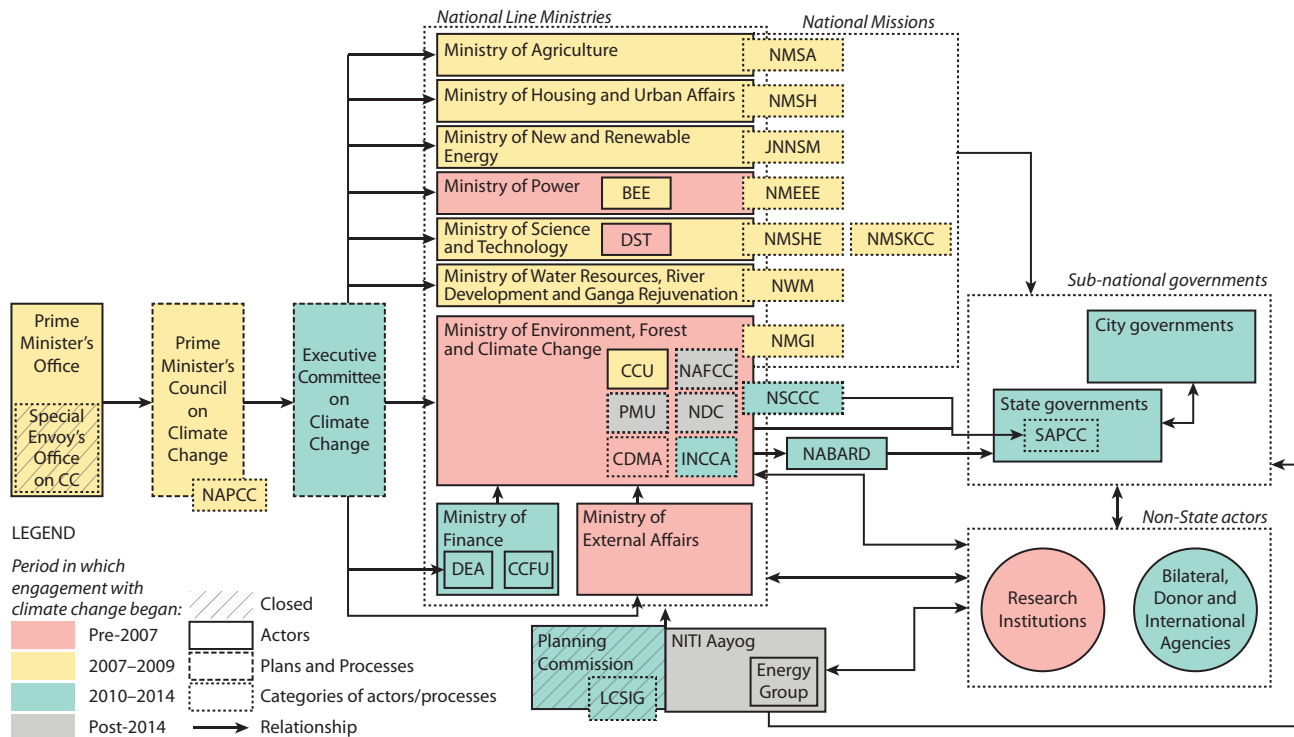


Figure 19.1 Institutions in India's Climate Change Governance

(cont'd)

Figure 19.1 (cont'd)

Note: The abbreviations used in the figure are as follows: BEE: Bureau of Energy Efficiency; CC: Climate Change; CCFU: Climate Change Finance Unit; CCU: Climate Change Unit; CDMA: Clean Development Mechanism Authority; DEA: Department of Economic Affairs; DST: Department of Science and Technology; INCCA: Indian Network for Climate Change Assessment; JNNSM: Jawaharlal Nehru National Solar Mission; LCSIG: Expert Group on Low Carbon Strategies for Inclusive Growth; NABARD: National Bank for Agriculture and Rural Development; NAFCC: National Adaptation Fund on Climate Change; NAPCC: National Action Plan on Climate Change; NDC: Nationally Determined Contribution; NMEEE: National Mission on Enhanced Energy Efficiency; NMGI: National Green India Mission; NMSA: National Mission for Sustainable Agriculture; NMSH: National Mission on Sustainable Habitat; NMSHE: National Mission for Sustaining the Himalayan Ecosystem; NMSKCC: National Mission on Strategic Knowledge for Climate Change; NSCCC: National Steering Committee on Climate Change; NWM: National Water Mission; PMU: Project Management Unit; SAPCC: State Action Plan on Climate Change.

Source: Dubash et al. (2018a).

Pre-2007: Climate, a Foreign Policy Issue—Limited Institutional Engagement

Prior to 2007, climate policy in India was seen as a matter of foreign policy. As India championed the importance of equity in climate negotiations and articulated the concept of ‘differentiated responsibility’, diplomatic negotiations were led by a small number of experienced officials from the Ministry of External Affairs and the MoEF. Parliament, the Prime Minister’s Office (PMO), or the Cabinet had little engagement with the process. Some sectoral line ministries, like the MoP and the Department of Science and Technology, provided inputs on technical matters and there were links with a few research organizations. The one domestic institutional action that, however, did take place was the constitution of the National Clean Development Mechanism Authority in 2004, within the MoEF, to facilitate the participation of Indian companies in the Clean Development Mechanism under the Kyoto Protocol (MoEF 2004).

2007–9: Domestic Climate Policy Formulation Begins—Significant Climate Institutionalization

From 2007, there was a shift in international climate negotiations. Along with the developed world, even large developing countries like India and China were now coming under intense pressure to formulate domestic mitigation actions. In India, this period witnessed a lot of activity on the climate institutions front. In June 2007, Prime Minister Manmohan Singh constituted the PMCCC—a high-level advisory body with ministers and heads of key ministries and departments, as well as non-governmental organizations and media houses. Notably, the prime minister held charge of the MoEF at this time, which may account for the high level of activity on the subject during this period.³ The PMCCC was charged with the task of coordinating ‘national action plans for assessment, adaptation and mitigation of climate change’, and advising the government on measures to deal with climate change (Government of India 2007). The Office of

³ Interview with Dr S. Satapathy, former MoEFCC official, 5 October 2018.

the Special Envoy on Climate Change was also set up within the PMO in January 2008 to assist with international and domestic climate policymaking, as well as specifically facilitate coordination between different agencies. The PMCCC initiated the formulation of a national strategy to address climate change, a process brought to close by the special envoy, and finally, the document was released as the NAPCC in June 2008.

The release of the NAPCC triggered significant climate institutionalization. The nodal central ministries responsible for the eight national missions embarked on the process of framing mission documents. The process varied across different ministries, and some were supported by the special envoy's office in their efforts (Dubash and Joseph 2016).

Jairam Ramesh, appointed as the environment minister in mid-2009, initiated efforts to increase domestic knowledge capacity around climate change. For instance, the Indian Network for Climate Change Assessment (INCCA)—a network of 127 institutions—was set up to examine climate change impacts, prepare greenhouse gas (GHG) inventories, and provide a mechanism to coordinate research in the country. In the run-up to the Copenhagen COP, India announced a 20–5 per cent reduction in the emissions intensity of its economy from 2005 levels by 2020. During this time, Parliament also discussed the issue of climate change on several occasions, particularly before and after the COP at Copenhagen (Lok Sabha, 2009; Rajya Sabha, 2009).

2010–mid-2014: Environment Ministry Takes Lead in Inter-ministerial Coordination

In March 2010, due to inter-institutional tensions, the Office of the Special Envoy was closed and the task of coordination of climate policy across the government fell to the MoEF. Although the then Environment Minister Jairam Ramesh took personal interest in ensuring coordination across ministries, unlike the special envoy, he did not enjoy the heft of the PMO, and inter-ministerial power equations often came in the way of effective coordination on domestic actions on climate change. To overcome this problem, a new Executive Committee on Climate Change (ECCC), chaired by the

principal secretary to the PM was constituted (PMO 2013). It was composed of secretaries of all relevant ministries, who could speak for their respective ministries and therefore ease coordination challenges.

Meanwhile, climate finance became an important point at climate negotiations; and one of the outcomes of the Cancun COP was a US\$100 billion by 2020 pledge by developed countries. A Climate Change Finance Unit (CCFU) was created in the MoF in 2011 to act as the nodal point on climate change financing-related issues for the MoF and to provide guidance and inputs to the MoEF during negotiations. In 2012, the National Bank for Agriculture and Rural Development (NABARD) was accredited as the National Implementing Entity for the Adaptation Fund under the United Nations Framework Convention on Climate Change (UNFCCC).

Efforts to develop SAPCCs were initiated during this period. To ensure that the SAPCCs were designed and implemented in accordance with the NAPCC, a National Steering Committee on Climate Change (NSCCC), composed of secretaries of various ministries and departments, and chaired by the environment secretary, was constituted in February 2011 (MoEF 2011). The design and implementation of the national missions progressed at varying pace in each line ministry. Although specific personnel were assigned to climate change-related tasks, often as part of mission directorates, climate institutionalization within these ministries remained thin.

Mid-2014 to Present: Climate Institutionalization Slows Down

Soon after coming to power, the Modi government renamed the MoEF as the Ministry of Environment, Forest and Climate Change—signalling, perhaps, an intention to take seriously the challenge of climate change. However, this period has not seen significant growth in climate institutions or enhancement of the government's capacity to consider climate issues. The Climate Change Division at the Environment Ministry currently has a core team of 7 persons working on climate issues, which is assisted by a group of 12–15 persons engaged on a consultancy basis.⁴ There has been some streamlining

⁴ Telephone interview with Ajay Raghava, MoEFCC official, 11 October 2018.

of the Biennial Update Report (BUR) preparation process under the UNFCCC. A Project Management Unit (PMU) has been set up within the MoEFCC to coordinate the preparation of the BUR, and the first BUR was submitted in 2015. The process involved not just the relevant ministries and departments but also 17 expert institutions which compiled data on GHG emissions, mitigation actions, and other components of the BUR.⁵

The government has also established a National Adaptation Fund on Climate Change (NAFCC), with a budget provision of 350 crores (about US\$50 million) over two years, 'to assist States that are particularly vulnerable, based on the needs and priorities identified under the SAPCC and the relevant Missions under NAPCC' (MoEFCC 2015b). The NABARD has been designated as the National Implementing Entity for financing adaptation projects under the NAFCC.

The past decade has witnessed a rise in climate institutions in India, but it has been a reactive and ad hoc process. It has not led to the creation of stable, long-lasting, and well-coordinated institutions and governance processes that can appropriately respond to climate concerns. A survey of the websites of relevant line ministries reveals that the number of personnel working on climate issues is still very small (see Table 19.2); and their lack of capacity is aggravated by the fact that the personnel are not exclusively working on climate issues. The cross-sectoral nature of the climate problem also requires government officials to understand the linkages of climate change with other issues, like urbanization, energy, agriculture, water scarcity, disaster management, and so on, but currently, there is no mechanism to mobilize such knowledge sharing (Dubash and Joseph 2016). Although the MoEFCC is the nodal agency dealing with climate change in the government, policymaking and implementation of climate actions has been fragmented and has met with varying degrees of success as different line ministries are responsible for each mission under the NAPCC. A December 2018 report of the Parliamentary Committee on Estimates on the performance of the NAPCC has underscored the importance of coordination and

⁵ Personal interview with Dr J.R. Bhatt, MoEFCC official, 4 December 2017.

Table 19.2 Personnel Working on Climate Change Issues in the Line Ministries

Ministry	Designation	Special/Additional Joint Secretary/ Scientist(G)/ Advisors	Director/Dep. Secretary/Scientist (D.E.F)/Joint Director	Under Secretary/ Scientist(C)/ Dep. Director	Section Officer/ Desk Officer	Consultants
<i>Ministry of External Affairs</i> ¹			•			
<i>Ministry of Environment, Forest and Climate Change</i> ²	• • •		• • • •	•	•	• • • • • • • • • • • • • • • • •
<i>Ministry of Finance</i> ³	•		•	•		
<i>Ministry of New & Renewable Energy</i> ⁴	• • • • •		•	• • • • •		
<i>Ministry of Power</i> ⁵	•		•	•		
<i>Bureau of Energy Efficiency</i> ⁶	• • •		• • • • • • • •			
<i>Ministry of Agriculture and Farmers' Welfare</i> ⁷	• •		•	• •		•
<i>Ministry of Water Resources, River Development and Ganga Rejuvenation</i> ⁸	• • •		•	• •		• • • • • •

(cont'd)

Table 19.2 (cont'd)

<i>Ministry of Science & Technology</i> ⁹	• •	• •	•		
<i>Ministry of Housing & Urban Affairs</i> ¹⁰	N/A	N/A	N/A	N/A	N/A

Notes: Each black circle represents one official in that category working on climate change and/or involved in the implementation of a relevant mission under the NAPCC. Data are updated from Dubash and Joseph (2016), based on websites of Government of India ministries and BEE, supplemented by written requests for information and telephone interviews with ministry officials.

Sources:

¹ One official in the United Nations Economic and Social (UNES) Division is shown as in-charge of climate change. An email enquiry elicited no further information. See <https://www.mea.gov.in/divisions.htm>; accessed on 24 October 2018.

² See <http://www.moef.nic.in/division/contact-us-23> and <http://www.moef.nic.in/about-ministry/chart1-environment-wing>; accessed on 24 October 2018. Information verified by phone interview with Ajay Raghava, MoEFCC official, 11 October 2018.

³ See <https://dea.gov.in/divisionbranch/climate-change-finance-unit>; accessed 24 October on 2018.

⁴ Data provided by Dr P.C. Maithani, ministry official, 9 October 2018, via phone interview. Although many officials in the ministry work in areas relating to renewable energy and climate change, Dr Maithani listed personnel working on policy linkages between renewable energy and climate change, as well as those working on NSM specifically.

⁵ See https://powermin.nic.in/sites/default/files/uploads/Organisation_chart_Ministry_of_Power.pdf; accessed on 24 October 2018.

⁶ Dubash and Joseph (2016). The Bureau of Energy Efficiency's (BEE) website does not provide information and we did not receive any response to the emails sent for verification.

⁷ See <https://nmsa.dac.gov.in/frmContacts.aspx>; accessed on 24 October 2018.

⁸ Subsequently re-named Ministry of Jal Shakti. See <http://nwm.gov.in/?q=organization-setup>; accessed on 24 October 2018.

⁹ See http://www.dst.gov.in/about-us/email-directory?field_tags_tid_1=2302; accessed on 24 October 2018.

¹⁰ See <http://mohua.gov.in/cms/National-Mission-on-Sustainable-Habitat.ph>; accessed on 24 October 2018.

collective action across various ministries and departments for the successful implementation of the NAPCC (Committee on Estimates 2018). It has recommended the constitution of a 'Mission Mode Authority', consisting of representatives of all missions and headed by the prime minister, to review implementation efforts, and to ensure an integrated, rather than fragmented, approach to climate change. Whether the government adopts this recommendation is yet to be seen.

Just over 10 years ago, climate change was considered an exclusively diplomatic and foreign policy issue in India. However, now, there is a slew of policy and institutional activity at the domestic scale. National and sub-national levels of government are internalizing climate change in various ways, as well as building linkages across climate and non-climate actions. This enhanced climate change-related activity has come about as the result of the interplay between international and domestic drivers, although domestic factors have been determinative. The formulation of the NAPCC, sparked by international pressure, set in motion a series of institutional and planning processes through the eight national missions, and introduced the co-benefits approach to climate policymaking in India. In the international arena, India has tended to reflect domestic actions, rather than international pledges driving domestic actions. For example, India's NDC is more a compilation of ongoing actions than guidelines for development of future action. Mirroring active policymaking has been the growth in institutions dealing with climate change. Spaces have been created within existing ministries and departments, and through new inter-agency bodies to strategize on climate issues, and develop or deepen the cross-sectoral linkages. However, the government's institutional capacity on climate issues continues to be low, and needs significant enhancement for substantive engagement. As India intensifies its efforts to mainstream climate change in the development agenda, climate policymaking in the country will continue to be driven, or restrained, by domestic imperatives and the country's institutional capacity to influence political decision-making.

References

- Atteridge, A., M.K. Srivastava, N. Pahuja, and H. Upadhyay. 2012. 'Climate Policy in India: What Shapes International, National and State Policy?', *Ambio*, 41(Suppl. 1): 68–77. Available at <https://doi.org/10.1007/s13280-011-0242-5>.
- Byravan, Sujatha and Sudhir Chella Rajan. 2012. 'An Evaluation of India's National Action Plan on Climate Change', Social Science Research Network, Rochester, NY. Available at <http://ifmrlead.org/wp-content/uploads/2016/05/NAPCC%20Evaluation.pdf>.
- Committee on Estimates (2018–2019). 2018. 'Performance of the National Action Plan on Climate Change: Thirtieth Report'. In Sixteenth Lok Sabha. New Delhi: Lok Sabha Secretariat. Available at http://164.100.47.193/lssccommittee/Estimates/16_Estimates_30.pdf; accessed on 11 June 2019.
- Dubash, Navroz K. 2011. 'From Norm Taker to Norm Maker? Indian Energy Governance in Global Context', *Global Policy*, 2(s1): 66–79. Available at <http://onlinelibrary.wiley.com/doi/10.1111/j.1758-5899.2011.00123.x/full>.
- . 2013. 'The Politics of Climate Change in India: Narratives of Equity and Cobenefits', *Wiley Interdisciplinary Reviews: Climate Change*, 4(3): 191–201. Available at <https://doi.org/10.1002/wcc.210>.
- Dubash, Navroz K. and Neha B. Joseph. 2016. 'Evolution of Institutions for Climate Policy in India', *Economic & Political Weekly*, 41(3): 44–54.
- Dubash, Navroz K. and Radhika Khosla. 2015. 'Neither Brake Nor Accelerator', *Economic & Political Weekly*, 50(42): 10–14.
- Dubash, Navroz K., Radhika Khosla, Ulka Kelkar, and Sharachchandra Lele. 2018a. 'India and Climate Change: Evolving Ideas and Increasing Policy Engagement', *Annual Review of Environment and Resources*, 43. Available at <https://doi.org/10.1146/annurev-environ-102017-025809>.
- Dubash, Navroz K., Radhika Khosla, Narasimha D. Rao, and Ankit Bhardwaj. 2018b. 'India's Energy and Emissions Future: An Interpretive Analysis of Model Scenarios', *Environmental Research Letters*, 13: 074018. Available at <https://doi.org/10.1088/1748-9326/aacc74>.
- Economic & Political Weekly*. 2008. 'Climate Change: Not Vision, Not Plan', 43(28): 5–6.
- Government of India. 2007. 'PM's Council on Climate Change Constituted'. Available at <http://archivepmo.nic.in/drmanmohansingh/press-details.php?nodeid=575>; accessed on 31 October 2018.
- Khosla, Radhika and Navroz K. Dubash. 2015. 'What Does India's INDC Imply for the Future of Indian Electricity?', 15 October. Available at <https://cprclimateinitiative.wordpress.com/2015/10/15/>

- what-does-indias-indc-imply-for-the-future-of-indian-electricity/; accessed on 31 October 2018.
- Khosla, Radhika, Srihari Dukkupati, Navroz K. Dubash, Ashok Sreenivas, and Brett Cohen. 2015. 'Towards Methodologies for Multiple Objective-Based Energy and Climate Policy', *Economic & Political Weekly*, 50(49): 49–59.
- Lok Sabha. 2009. 'Discussion Regarding Impact of Climate Change' Session XV-III (19th November–18th December, 3 December 2009, reproduced in Navroz K. Dubash (ed.) 2012, *Handbook of Climate Change and India*. New Delhi: Oxford University Press.
- Ministry of Environment and Forests (MoEF). 2004. 'MoEF Notification S.O. 515(E)'. Available at <http://ncdmaindia.gov.in/ViewPDF.aspx?pub=notification.pdf>; accessed on 31 October 2018.
- . 2011. 'Reconstitution of the National Steering Committee (NSC) on Climate Change ... Regarding'. Available at http://mahenvis.nic.in/Pdf/Laws/cc_reconstitution_nsc_260911.pdf; accessed on 31 October 2018.
- Ministry of Environment, Forest and Climate Change (MoEFCC). 2015a. 'India's Intended Nationally Determined Contribution: Working towards Climate Justice', Press Information Bureau. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=128403>; accessed on 31 October 2018.
- . 2015b. 'Government has Established National Adaptation Fund on Climate Change: Javadekar', Press Information Bureau. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=124326>; accessed on 31 October 2018.
- Ministry of Finance (MoF). 2015. 'From Carbon Subsidy to Carbon Tax: India's Green Actions'. Press Information Bureau. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=116058>; accessed on 31 October 2018.
- . 2016. 'Additional Resource Mobilization for Agriculture, Rural Economy and Clean Environment', Press Information Bureau. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=136995>; accessed on 31 October 2018.
- Ministry of Power (MoP). 2015. 'Initiatives to Improve the Efficiency of Coal Based Power Plants', Press Information Bureau. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=116893>; accessed on 31 October 2018.
- NITI Aayog. 2016. *Knowledge Initiatives: National Conference on Energy: Data Management, Modelling and GIS Mapping*. New Delhi: NITI Aayog.

- Permanent Mission of the People's Republic of China to the UN. 2007. 'China's National Climate Change Program (June 2007)', 4 June. Available at <http://www.china-un.org/eng/gyzg/t626117.htm>; accessed on 31 October 2018.
- Press Information Bureau. 2016. 'Cabinet Approves Pradhan Mantri Ujjwala Yojana—Scheme for Providing Free LPG Connections to Women from BPL Households'. Available at <http://pib.nic.in/newsite/printrelease.aspx?relid=137647>; accessed on 31 October 2018.
- Prime Minister's Council on Climate Change (PMCCC). 2008. 'National Action Plan on Climate Change'. Available at <http://www.moef.nic.in/downloads/home/Pg01-52.pdf>; accessed on 31 October 2018.
- Prime Minister's Office (PMO). 2013. 'Executive Committee on Climate Change Constituted', Press Information Bureau. Available at <http://pib.nic.in/newsite/erelease.aspx?relid=91924>; accessed on 31 October 2018.
- Rajya Sabha. 2009. 'Session 218, Tuesday, December 2009', reproduced in Navroz K. Dubash (ed.) 2012, *Handbook of Climate Change and India*. New Delhi: Oxford University Press.
- Rattani, Vijeta. 2018. 'Coping with Climate Change: An Analysis of India's National Action Plan on Climate Change'. Available at <https://www.cseindia.org/coping-with-climate-change-8488>; accessed on 31 October 2018.
- Somanathan, Eswaran, Thomas Sterner, Taishi Sugiyama, Donald Chimanikire, Navroz K. Dubash, Joseph Kow Essandoh-Yeddu, Solomon Fifta, Lawrence Goulder, Adam Jaffe, Xavier Labandeira et al. 2014. 'National and Sub-national Policies and Institutions', in *Climate Change 2014 Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier et al. (eds), pp. 1141–205. Cambridge: Cambridge University Press. Available at https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter15.pdf.
- The Energy and Resources Institute (TERI). 2009. *India's Energy Security: New Opportunities for a Sustainable Future*. New Delhi: TERI.

From Margins to Mainstream?^{*}

State Climate Change Planning in India

Navroz K. Dubash and Anu Jogesh

For much of the last two decades, climate change has largely been considered an esoteric issue in India, to be discussed in international negotiations, but not one of much salience to domestic development imperatives. This has always been a flawed understanding, because climate change impacts can make the task of developing in a sustainable manner much harder. As the Intergovernmental Panel on Climate Change's (IPCC) *Fifth Assessment Report* notes, 'sufficiently disruptive climate change could preclude any prospect for a sustainable future' (Fleurbaey et al. 2014: 5). More recently, however, there has been growing awareness of the relevance of climate change for India, both within government and other sectors of society, such as civil society, business, and media (Dubash 2012). ...

* This chapter is an excerpt reprinted from Navroz K. Dubash and Anu Jogesh. 2014. 'From Margins to Mainstream? State Climate Change Planning in India'. *Economic & Political Weekly*, 49(48): 86–95.

In response, at least initially, to growing international clamour for domestic adoption of climate strategies among emerging economies, India prepared its National Action Plan on Climate Change (NAPCC). The initiative was ostensibly aimed at two outcomes—to adapt to climate change and ‘further enhance the ecological sustainability of India’s development path’ (Prime Minister’s Council on Climate Change [PMCCC] 2008: 1).

In August 2009, the prime minister (PM) asked all states to develop State Action Plans on Climate Change (SAPCCs) (Press Information Bureau 2009). The rationale was to decentralize action beyond the eight missions of the NAPCC, particularly, given that many subjects covered—especially those like water and agriculture—are actually state subjects and tackle issues necessitating adaptation interventions. The Ministry of Environment, Forest and Climate Change (MoEFCC), earlier called Ministry of Environment and Forests (MoEF),¹ developed a ‘common framework document’, with the assistance of some donor agencies, to guide this process, stressing that it be participatory, build capacity, develop a vulnerability assessment, and draw on experts and donors for guidance and support (MoEF 2010a). A number of states embarked on the ambitious plan formulation processes. As of October 2014, 28 states and union territories have completed drafts of their plans; 19 have been endorsed by the MoEF and 3 have been considered by the Expert Committee on Climate Change (MoEF 2014).

To what extent do these newly forged state climate plans and the underlying process of their creation shift climate change from the margins to the mainstream of India’s development debate? This is an important question to ask for several reasons. First, in the light of challenges posed by climate change, a business-as-usual approach to sustainable development is likely to be increasingly ineffective. Second, state planning for climate change affords an intriguing opportunity to revisit existing development planning in ways that prompt more explicit attention to environmental sustainability.

¹ The MoEF was renamed MoEFCC in May 2014. For the purpose of this chapter, the earlier acronym of MoEF is employed as many of the documents and web pages pertaining to the study refer the old name.

Third, and most pragmatically, SAPCCs are unlikely to be a one-off exercise; the current round of plans will have to be reviewed, updated, and improved upon in an iterative process. Given this, it is important to document the lessons of experience.

A summary response to the aforementioned overarching question is that state climate plans have been a ‘door opener’,² as one official put it, to a more in-depth engagement with the concepts and implementation challenges of sustainable development, but they have not, as yet, provided an opening for transformative change—the ‘directional shift’ called for in the NAPCC (PMCCC 2008: 7). ...

Approach and Methodology

The study draws on an analysis of state climate plans in five states:³ Himachal Pradesh (HP),⁴ Karnataka,⁵ Madhya Pradesh (MP),⁶ Odisha,⁷ and Sikkim.⁸ The states were primarily chosen to represent geographic spread and variability in donor organizations involved, with additional attention to agro-climate variability, size, and economic prosperity. Further, only states that had completed a draft report were considered when this study was initiated in May 2012.

² Interview with Felix Nitz, former technical advisor, Environmental Management and Policy Research Institute (EMPRI), Government of Karnataka, Bengaluru, Karnataka, 28 September 2012.

³ In some cases, there are multiple versions of climate plans in the public domain; this study uses the most recent version. The plans, in general, are referred to as State Action Plans on Climate Change (SAPCCs).

⁴ See Department of Environment, Science and Technology, Government of HP (2012). Hereafter cited as HP climate plan.

⁵ See Environmental Management and Policy Research Institute (EMPRI), Government of Karnataka, and The Energy and Resources Institute (TERI) (2012). Hereafter cited as Karnataka climate plan.

⁶ See Housing and Environment Department, Government of MP (2012). Hereafter cited as MP climate plan.

⁷ See Department of Forest and Environment, Government of Odisha (2010). Hereafter cited as Odisha climate plan.

⁸ See Government of Sikkim (2011). Hereafter cited as Sikkim climate plan.

The report is based on interviews with officials from nodal and department ministries in each state, civil society actors, consultants, and donors. The interviews are complemented by close analysis of state plans and supporting documents. The approach is primarily qualitative and interpretive. ...

Framing State Climate Plans in India

Linking Climate Change with Sustainable Development

In many states, climate change action plans were approached as sustainable development action plans. A low level of initial knowledge about climate change in some states, a lack of a conceptual framework with which to link sustainability and climate change, limited access to appropriate state-level climate science projections, and, in some cases, pressures on time, all led to a default approach of broad sustainability planning. Interviews with state officials suggest that while climate change is often a little understood abstraction, there is greater motivation to address concrete local issues of sustainable development, which is also likely to bring greater political support for action. Viewed thus, state climate change plans may be understood, as one state official put it, as a useful 'door-opener' to consideration of long-standing sustainable development concerns, since there is a considerable overlap between sustainability and climate resilience.⁹

On the other hand, understandings of sustainable development are incomplete without taking account of future climate change impacts. For example, changes in future rainfall trends have impacts for the trajectory of hydropower development, and sea-level rise carries implications for infrastructure development along the coast. ...

The incomplete framing of sustainable development in the context of climate change is partly due to limitations at the initiation stage of plans. As an official from MP put it, 'SAPCCs [are] not climate change plans but good development plans. States were thrown into the process without capacities to understand the process or the product....'¹⁰

⁹ Interview with Felix Nitz, 28 September 2012, Bengaluru, Karnataka.

¹⁰ Not for attribution interview with a state official, Government of MP, 29 August 2012, Bhopal, MP.

Use of Science

State plans made limited use of relevant scientific knowledge on climate change, in large part because of difficulties in accessing such knowledge, which is an important reason why they failed to upgrade sustainable development to include climate resilience....¹¹

While all states conducted a vulnerability assessment, the effectiveness of these was limited by lack of adequate regional-level climate predictions and adequate scientific capability. The Odisha and Sikkim state plans, for instance, derive sectoral and region-wise climate sensitivity from current climate trends rather than future projections (Odisha climate plan: 12; Sikkim climate plan: 3). ...

Consequently, even where science-based information is available, there is little evidence that final plan recommendations reflect priority areas based on science. For example, in MP ... climate-specific information was added later, after the first iteration of the report was ready, but does not seem to inform plan recommendations.¹² Odisha, which prepared a draft in just three months, did not carry any climate forecasts. ...

Balancing National Direction and Local Concerns

In India's federal system, there is an inevitable tension between the consistency obtained by a centrally directed approach and the gains of tailoring policy to the local context when states take the lead. Taking guidance from the MoEF, states largely followed the template of the eight missions laid out under the NAPCC (MoEF 2010a). Indeed, even the recommendations sections of some plans followed the sub-categories listed under the missions (Ogra 2013).

At the same time, local concerns did play a role in shaping both the content of the plans and some additional emphasis on certain sectoral areas. For example, the Odisha climate plan was seen as a way to bring in much-needed funds to reduce transmission and distribution losses in the state's privatized electricity sector, even though this is not a major theme in the NAPCC. As one official noted, 'Nothing

¹¹ Interview with Lokendra Thakkar, coordinator, Climate Change Cell, Environmental Planning and Coordination Organisation (EPCO), Government of MP, 29 August 2012, Bhopal, MP.

¹² Interview with Lokendra Thakkar, 29 August 2012, Bhopal, MP.

was moving in the [energy] sector.... In the name of climate change, highlight that the sector needs support ... we would not have got support without the climate document.’¹³ Indeed, a third of the plan budget is set aside for this purpose (Odisha climate plan: 107–8). In Sikkim, water issues dominate state concerns around glacial retreat, given the dependence of the state on mountain springs for water supply (Sikkim climate plan: 9). ...

The climate plan process has, therefore, found a balance between laying out a broad framework set by the Centre and leaving space for state direction. In the future, it may be advisable to tilt the balance in favour of state initiative for at least three reasons: many climate-relevant issues are state subjects; implementation chances are heightened if states can focus on issues that are politically salient locally; and experimentation at the state level is more likely to lead to creative new ideas than a fixed central diktat.

Role of Mitigation in State Climate Plans

Among some state officials, there was a clear sentiment that it was appropriate for state plans to focus on adaptation issues, one backed by the MoEF.... As a senior official in MP said, ‘we would only engage in mitigation activities if it offered a win-win situation for the state’s development agenda.’¹⁴

However, ... there were some confounding factors that led to mixed signals on the relative balance of plans on adaptation and mitigation. First, the NAPCC, which served as the guiding document for state plans, includes several missions focused on mitigation (PMCCC 2008). Second, the common framework document issued by the MoEF explicitly states that each plan should include a greenhouse gas (GHG) inventory, which by its nature is mitigation focused (MoEF 2010a). Finally, some states had an interest in pursuing energy-related issues in their plans.

¹³ Interview with Pradeep Jena, regional director, Reserve Bank of India, Odisha, former principal secretary, Department of Energy, Government of Odisha, 22 May 2012, Bhubaneswar, Odisha.

¹⁴ Interview with Avani Vaish, former chief secretary, Government of MP, 7 September 2012, New Delhi.

In such states where local importance was given to mitigation issues, mitigation-related actions formed a substantial (though rarely a majority) component of final SAPCC recommendations. Examples include Odisha's focus on reducing losses in the electricity system (Odisha climate plan: 430), Karnataka's efforts to restructure agricultural power tariffs (Karnataka climate plan: 165), and HP's exploration of payment for ecosystem services as well as acquiring more carbon credits through the Clean Development Mechanism (CDM) process (HP climate plan: 215).

However, while some states conducted a GHG inventory, not all chose to include these in the final plan. Interviews in four states suggested that feedback from the MoEF (contrary to the guidance initially presented in the common framework document) advised against inclusion of these inventories on the grounds that it might unnecessarily expose India to international pressure. As a consultant to Sikkim and MP put it, 'The MOEF is not encouraging it [inclusion of GHG inventories] at this point even though it's in the framework since bi-laterals and multilaterals can pick up state numbers and informally push their cause [for India taking on emission cuts].'¹⁵

While concerns about opening the door to international obligations may be understandable, these concerns are alleviated by the NAPCC's emphasis on a co-benefits framework for Indian action, which places an emphasis on development first, and the fact that many states appear to have their own interests in pursuing energy-related actions in a co-benefits context (PMCCC 2008: 28). ...

The Process

The process through which a state develops its climate plan can either open doors to creative ideas or close off opportunities, empower voices outside the mainstream or silence them. Accordingly, exploring the process followed by states is an essential precursor to looking at their outcomes. ...

¹⁵ Interview with Sumana Bhattacharya, Head—Climate Change and Sustainability, Intercooperation, India, 6 August 2012, New Delhi.

Local Political and Bureaucratic Support as Plan Drivers

Climate change plans have occasionally received high-level political support in an effort to project a green image, which has translated to bureaucratic attention. The chief ministers of some states, notably Sikkim, HP, and Odisha, have been reported as being keen to project their state as environmentally forward-thinking. As one official noted, 'We wanted to make sure through these [climate initiatives] that HP had a good track record of proactiveness with respect to environment matters.'¹⁶ ... The Sikkim chief minister constituted a 'State Council on Climate Change' well before the SAPCC process, and also established a 'Glacier and Climate Change Commission' (Tambe and Arrawatia 2012: 278). Himachal Pradesh hosted a Climate Change Conclave and announced a climate-neutral target for the state to be addressed with assistance from the World Bank (Government of HP and Leadership for Environment and Development [LEAD], India 2009; Press Trust of India 2009, 2011). High levels of political attention translated to bureaucratic energy and proved helpful in mobilizing bureaucrats from other departments. ...

The Role of the Nodal Agency and Other Line Departments

The process of formulating state plans followed one of two broad models. In Karnataka, HP, and MP, the plan was drafted by the nodal department after obtaining inputs from relevant departments. In Odisha and Sikkim, the plan was drafted by sectoral working groups formed by the nodal group. Comparing the two approaches, the nodal group-led model provided almost no scope for cross-departmental input or new ideas from within the process. In all three states though, state plans were able to draw on external ideas—the expert-led Bangalore Climate Change Initiative – Karnataka (BCCI-K) process in Karnataka, the peer-review group consisting of academics and chancellors from several universities in HP, and

¹⁶ Interview with Nagin Nanda, joint secretary, Empanelled with the Government of India, Former Director-cum-Secretary (Environment), Department of Environment, Science and Technology, Government of HP, 7 February 2013, Shimla, HP.

sectoral workshops in MP involving line departments and retired government officials.¹⁷

Done well, the working group-focused model can provide the basis for new ideas and breaking of silos. For example, a stakeholder commenting on the Odisha plan remarked: 'It is not often that you find forest officers sitting face to face with mining officials to discuss environmental sustainability' (Mani 2010). In Odisha, representatives of the nodal agency were also strategically placed in each group to ensure progress.

However, to ensure cogency with the broader process, the plan process must be carefully designed to both foster interaction (and avoid silos) but also build ownership. This is a challenge, since there is a possible trade-off across these objectives. Ensuring interaction through cross-departmental discussion using a nodal agency to stimulate discussion rather than own the process, and allowing time for new understandings to emerge, are all important ingredients of a good process.

Extent of External Participation

In addition to cross-departmental deliberations, external input commissioned from academics and consultants, or consultation with stakeholders from business and civil society, can provide sources of creative input. In several states, the formal process was supplemented with either *ex ante* or *ex post* consultation, but these were highly variable in quality and effort, and there is only limited evidence that consultation had a tangible effect on outcome.

For example, HP set up a peer-review group comprising vice chancellors of universities as well as eminent scientists to vet the draft plan. Their most significant intervention was guiding the nodal department in preparing a new district-level vulnerability assessment study using climate-based variables to replace an existing environmental vulnerability assessment study.¹⁸ However, the process in HP

¹⁷ Interview with Felix Nitz, 28 September 2012, Bengaluru, Karnataka; Interview with Lokendra Thakkar, 29 August 2012, Bhopal, MP; Interview with Nagin Nanda, 7 February 2013, Shimla, HP.

¹⁸ Interview with Nagin Nanda, 7 February 2013, Shimla, HP.

failed to provide space to civil society voices. The most ambitious example of *ex ante* consultations is in MP, where the nodal agency organized regional workshops in 11 agro-climatic zones, resulting in a synthesis of sector-wise concern areas and recommendations for each agro-climatic zone (MP climate plan: 19). However, since the main report writing proceeded in parallel, there is no indication of the impact of these consultations on the final plan.

To be effective, external input needs adequate time, appropriate sequencing with plan preparation processes, and the inclusion of both *ex ante* and *ex post* elements.

Capacity Building and External Support

State climate planning processes are typically housed in environment and forests or science and technology departments with limited capacity to conceptualize and develop climate plans.¹⁹ In all the states studied, there was considerable concern that the state plan be locally driven; in practice, states drew on external technical ability in a variety of ways. In some cases, donor agencies were explicitly involved in the process, as in Odisha, while in other cases, donors were engaged indirectly, through support for larger, related programmes, as in Sikkim, HP, and MP. Donors, in some cases, bridged capacity shortfalls by providing technical expertise, and facilitating a conversation on climate change with knowledgeable local bureaucrats, academics, and non-governmental organizations (NGOs). The assistance of donors and consultants, however, failed to enhance states' long-term capacity on climate change. Most states conducted an inception workshop and/or prepared an initial scoping document with donor assistance. The impact of these efforts, however, varied. In Odisha, for example, the scoping report drafted by a United Kingdom (UK)-based academic consultant provided a list of recommended sectoral actions. The scoping report was used by working groups as a 'first cut' towards drafting the plan, arguably short-circuiting local discussion of priorities (Odisha climate plan: 3). In Sikkim, state officials

¹⁹ Interview with Anshu Bharadwaj, director, Center for Study of Science, Technology & Policy (CSTEP), 28 September 2012, Bengaluru, Karnataka.

suggested that an initial scoping workshop conducted by senior academics and other experts from around India was of relatively limited use, as the plan was ultimately framed around broad climate change issues, without an explicit effort to build a conceptual bridge from local realities to climate threats.²⁰ Ultimately, the inception workshops and other consultations supported by donors showed little signs of usefully facilitating a conversation about climate change in a manner that allowed for engagement with local concerns.

Apart from these workshops, Indian consultants often took on a substantial role in plugging knowledge gaps and provided assistance in coordinating and drafting the plans. ...

The challenge for effective state climate planning processes is to mesh external specialized knowledge of climate change with detailed local knowledge in ways that can mainstream climate change. To do so requires building local capacity over time, both within the government and in networks of local academic and civil society institutions. In most states, the process was geared substantially more towards producing a report, than to long-term building of capacity to work on integrating climate change into development practice in a sustained way.

Outcomes

Recommendations for sectoral actions are at the heart of what the state climate plans finally communicate. A systematic understanding of these recommendations and their import are stymied by the numbers and diversity of approaches to generating recommendations (see Table 20.1). However, a comparison of recommendations suggests at least two broad themes discussed later in the chapter.

Lack of a Systematic Framework for Formulation or Prioritization

States diverge in the extent to which they offer broad objectives or specific actions, but no state offers a clear, consistent, and well-argued set of recommendations that amount to either a vision or an action plan. For instance, generic recommendations across plans include promotion of 'integrated farming practices', 'fire

²⁰ Interview with Sandeep Tambe, 24 July 2012, Gangtok, Sikkim.

Table 20.1 Range of Priority Actions in State Plans and Recommendations for Further Research

State and Relevant Section	Number of Recommendations	Number of Recommendations for Future Research (% of total)	Comments
HP 'Indicative Action Plan 2012–17'	287	35 (12%)	Six different strategy and action lists present. No stated basis for prioritization of the indicative action plan.
Karnataka 'Priority Actions and Entry Points'	100	21 (21%)	31 priority actions (containing 100 implementation arrangements)—no stated basis for prioritization.
MP 'Strategies and Budget'	337	30 (9%)	Strategies provided in each sectoral chapter. No stated basis for prioritization of the final 'strategies and budget' list.
Odisha 'Sector-Wise Table of Key Priorities'	148	38 (26%)	A six-point template created for selection and prioritization.
Sikkim 'Actions' List in Sector Chapters	224	50 (22%)	Sectoral actions tagged to 5-, 10-, and 15-year timelines. No stated basis for selection of actions.

Source: HP climate plan, p. 224; Karnataka climate plan, pp. 25, 165; MP climate plan, p. 97; Odisha climate plan, p. 118; Sikkim climate plan, pp. 43–163.

management', 'river bank protection', 'native forest management', etc. (HP climate plan: 228; MP climate plan: 101; Odisha climate plan: 80; Sikkim climate plan: 43). The Sikkim state plan, which carries a recommendation as broad-based as riverbank protection, however, also offers a very specific suggestion of moving a bus depot from the capital city to a town on the outskirts, to decongest the main city centre (Sikkim climate plan: 134). In addition, the Karnataka plan, which recommends 'vaccination of livestock', also

suggests a specific measure such as making water-use audits mandatory for industries and allied sectors (Karnataka climate plan: 117, 171).

One reason for this variation is the lack of up-front agreement and clarity on exactly what the plans were meant to deliver. As one consultant involved in multiple states noted: 'Earlier officials said that SAPCCs need to include specific actions, now they want it to be more of a knowledge document. ...'²¹

Another factor is the relatively thin information base on which recommendations rest; specific action items need detailed information. Notably, recommendations include many ideas for future research, several of which are actually prerequisites to constructing an informed climate plan (see Table 20.1). Climate plans, therefore, are more appropriately viewed as the first step in an iterative process, rather than the launch pad for implementing policies.

With both approaches—nodal agency led or working group led—recommendations were derived through a bottom-up process. While this approach has the potential benefit of allowing for creativity and experimentation, it also resulted in a diversity of recommendations at different scales and degrees of specificity. ... Most states further tried to categorize their recommendations. In each case, however, there was no basis provided or discussed for prioritization. The approach is, perhaps, best summed up by the candid statement by an official in Karnataka that actions and their priorities were 'ocularly' decided.²²

The Process Did Not Facilitate a Rethinking of Development Pathways

The academic literature notes the important role of federal units as 'laboratories of innovation' (Schreurs 2008). Understood thus, state plans could contribute significantly to realizing the NAPCC's call for a 'directional shift in the development pathway' of India in

²¹ Interview with Arabinda Mishra, Director, Earth Sciences and Climate Change Division, TERI, 27 April 2012, New Delhi.

²² Not for attribution interview with a senior official, Government of Karnataka (Environment and Ecology), 28 September 2012, Bengaluru, Karnataka.

response to climate change (PMCCC 2008: 7). The process in most states, however—organized around sectoral working groups and chapters—was not conducive to rethinking development pathways, since it tended to reinforce existing approaches by departments. A stakeholder elaborated: ‘Poverty is a big issue, urbanisation, migration: NAPCCs don’t capture all developmental issues. The alignment is happening only for budgetary reasons.’²³

This approach may have been indirectly promoted by the Centre’s common framework document, which called for state plan recommendations to align with the NAPCC’s various missions (MoEF 2010a).

Where potentially transformational issues do emerge, they are inadequately explored in the formal process. For example, a controversial and debated statement introduced by the official in charge of the Odisha plan in its second phase calls for a cap on thermal power projects: ‘In the power sector I asked what is the carrying capacity of Odisha in power; the outer limit of coal-based power? I brought some scepticism into the development trajectory of the power sector.’²⁴ However, this statement did not come out of deliberation, nor was it engaged with in the plan process, but was promoted by one individual. In another example, in HP, the former chief minister announced a rather ambitious carbon-neutrality target for the state by 2020, but the SAPCC itself does not seriously engage with this commitment.

While the state plans may not have systematically explored directional shifts, they did provide an institutional vehicle for pursuit of some innovative ideas. In the current round of plans, innovation, creativity, and the potential for transformation are driven by individual initiative. In the future, the challenge will be to structure the process to systematically explore transformative change.

²³ Interview with Ritu Bharadwaj, India program manager, Institute of Industrial Productivity, former advisor, Climate and Environment, Department for International Development (DFID), 20 April 2012, New Delhi.

²⁴ Interview with Aurobindo Behera, 23 May 2012, Bhubaneswar, Odisha.

Implementation

In most states, the focus thus far has been on preparation of plans; discussion of implementation is largely preliminary. ...

Institutional Capacity for Implementation

The process of preparing state plans has contributed to the creation and entrenching of dedicated climate change institutions in all states except Karnataka. Sikkim and MP had climate change institutions in place before they undertook their plans; HP and Odisha proposed creating such institutions in the course of developing their plans (Government of HP 2009; Government of Odisha 2010; Government of Sikkim 2009; Sikkim climate plan: 234). The existing capacity of these units, however, was insufficient for stimulating and monitoring implementation.

An official in Odisha noted: 'We are a weak institutional sector, whether environment or climate change. Our strengths don't lie in institutional capacities.'²⁵ Although in most states implementation is likely to happen through line departments rather than directly by climate change units ... dedicated climate units will likely play an important monitoring and evaluation role. The coordinating and steering role of these units for future refinements of climate plans will only increase over time, further calling for capacity enhancement.

Mainstreaming of Recommendations into the Functioning of Line Departments

There is broad convergence across state plans that implementation will have to happen through line departments. Indeed, most plans in their sectoral lists mention specific departments and agencies responsible for that area of work (Karnataka climate plan: 165; MP climate plan: 97; Odisha climate plan: 100; Sikkim climate plan: 43).

However, there is no agreement on the mechanisms through which this implementation can be achieved. In Odisha, the process

²⁵ Interview with Ashok Singha, MD, CTRAN Consulting, 22 May 2012, Bhubaneswar, Odisha.

of working groups was explicitly aimed at creating ownership among line departments, in the anticipation that they would take up aspects of the plan. ... Perhaps the most intriguing idea arose from MP, where the approach suggested is one of providing departments services such as advisories of progress towards goals and checklists, as a way of inducing or 'nudging' states towards action. As a senior MP official describes the approach: 'We hope to make a checklist and send it to various departments for them to see how projects can be made more climate friendly and compatible. This would be a voluntary initiative. We would ask for their policy assessment reports but we won't comment on it.'²⁶

These various indirect efforts to stimulate action arise from an acceptance that nodal agencies (typically environment departments or science and technology departments) do not have the heft to insist on action. And that sufficient financing is unlikely to be available to serve as an inducement to other line departments. Hence, building ownership over the relevance of the climate agenda to the work of the department is likely the only viable long-term solution, albeit one that is challenging to achieve in the face of competing demands and limited capacity.

Several officials involved with the state plans also noted the possible benefits of closer synergy with the state development planning process. For true mainstreaming of climate change, it is arguably counter-productive to have a development planning process and a parallel climate planning process that typically includes a wide range of departments.... As a consultant working in Odisha noted, 'we need to develop a[n] SAPCC which is not an independent entity but linked to the state planning document' (Centre for Policy Research 2013). ...

Securing Finance for State Climate Plans

The MoEF's common framework document requires that state plans estimate 'additional resource requirements' and explore 'existing and new and additional carbon finance potential' (MoEF 2010b). However, officials across states conveyed their reluctance to include

²⁶ Interview with Lokendra Thakkar, 29 August 2012, Bhopal, MP.

budgets for sectoral actions, adding that stated numbers were estimates at best and had no technical basis: 'It is a weak link for all states. If we had left it [budgetary allocations] blank, it would have given the document more academic credibility. ... The costs are currently indicative. ...'²⁷ Finally, some states have initiated actions without seeking additional funds, suggesting a promising indication of ownership of results and recommendations. Sikkim, for example, has deployed Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) funds to implement actions in the water sector, enabling some mainstreaming of climate concerns. Indeed, in interviews, some government officials indicated that finances were not the key constraint, but rather clarity on what to do and the capacity to implement actions. As one senior official noted:

[the stated budget] is not a big amount. The issue is how and where to spend it ... the state's plan budget [in 2011–2012] was 15,000 Crore Rupees, of that the state could not spend 2500 Crore Rupees and it was surrendered at the end of the year. This was supposed to have been spent on energy, water, fisheries, rural development.²⁸

State Action Plans on Climate Change hold potential as an important intervention in the development process. They provide an institutional platform to mainstream concerns of environmental sustainability into development planning and, if done properly, to update ideas of sustainability to include climate resilience. This platform provides a potential opening to enterprising and committed bureaucrats, but is also an opening with which development practitioners, academics, business, and civil society at large could productively engage.

At the moment, this promise is not being adequately realized. As discussed in this study, there are shortcomings in approach, process, formulation of outcomes, and implementation efforts. These shortcomings are united by a common thread—a tendency to prematurely

²⁷ Interview with Lokendra Thakkar, 29 August 2012, Bhopal, MP.

²⁸ Not for attribution interview with retired senior official, Government of Odisha, 23 May 2012, Bhubaneswar, Odisha.

view state climate plans as vehicles for generating implementable actions rather than an opportunity to re-direct development towards environmental sustainability and climate resilience. Thin conceptual frameworks, processes that provide no space for generating a vision of change, limited state capacity, and truncated time frames all reinforce this outcome.

While concrete actions are indeed important, these may be of limited value unless informed by a broader vision of future directions in key climate-related sectors such as agriculture, water, and energy.

However, if state plans are viewed as the beginning of a complex process rather than as an end in themselves, they provide a foundation upon which to build. Building on the analysis here, there are several specific measures that the central government, state governments, donor agencies, and civil society could adopt towards this end. Conceptually, plans would be more effective if built on a robust conceptual framework linking climate resilience and sustainable development, one which is also informed by science-based and state-level predictions of climate impact. Plan processes could more usefully prioritize longer-term transformative outcomes over short-term incremental actions as there are few existing processes that play this role. To do so, plans would need to develop a mechanism for generating fresh ideas, such as by drawing on the full range of stakeholders through adequate consultative processes, and by structuring silo-breaking interaction across departments. Organizing desired outcomes around integrative themes rather than sectoral recommendations are more likely to provide the desired 'directional shift' in development trajectories (PMCCC 2008: 7). Mechanisms to enhance the potential for effective implementation include developing a logical system of prioritizing outcomes and actions, ensuring sufficient capacity of nodal agencies to take follow-up action, and experimenting with creative ways of inducing policy actions in line ministries, particularly through information and analysis tools.

Given existing shortcomings, there is a risk of shifting into the implementation phase, as the Centre seems keen to do, somewhat prematurely. If state plans are to be transformational, going beyond cherry-picking existing projects and presenting them as climate projects, then it may be necessary to consider integrative approaches that cut across sectoral silos. Transformative approaches are also likely to transcend

the project mode and are better formulated as initiatives or programmatic efforts. The failure to develop adequate capacity to both design programmes, induce cooperation with mainstream departments, and monitor and track outcomes will also need rectification. ...

Growing evidence of real challenges to the achievement of sustainable development objectives due to climate threats provides compelling reasons for climate change planning to join the mainstream of development policy discourse. The state plans open the door to doing so, and invite the attention of not only environmentalists, but equally if not more importantly, of a wide range of development practitioners.

References

- Centre for Policy Research. 2013. 'State Action Plans on Climate Change in India: Framing, Processes, and Drivers', A report on the roundtable dialogue organized by the Centre for Policy Research, New Delhi, 27 April. Available at https://cdkn.org/wp-content/uploads/2013/05/SAPCC-Workshop-Report_CPR_27-April-2013_update.pdf; accessed on 6 June 2013.
- Department of Environment, Science and Technology, Government of Himachal Pradesh (HP). 2012. 'State Strategy & Action Plan in Climate Change: Himachal Pradesh', Shimla. Available at <http://re.indiaenvironmentportal.org.in/files/file/HPSCCAP.pdf>; accessed on 12 October 2013.
- Department of Forest and Environment, Government of Odisha. 2010. 'Orissa Climate Change Action Plan 2010–2015', Bhubaneswar. Available at <http://envfor.nic.in/downloads/public-information/Orissa-SAPCC.pdf>; accessed on 8 November 2013.
- Dubash, Navroz K. 2012. *Handbook of Climate Change and India: Development, Politics and Governance*. New Delhi: Oxford University Press.
- Environmental Management and Policy Research Institute (EMPRI), Government of Karnataka, and The Energy and Resources Institute (TERI). 2012. 'Karnataka State Action Plan on Climate Change: 1st Assessment', Government of Karnataka, Bengaluru. Available at <http://parisaramahiti.kar.nic.in/pubs/Karnataka-SAPCC-EMPRI-TERI-2012-03-22.pdf>; accessed on 12 October 2013.
- Fleurbaey, Marc, S. Kartha, S. Bolwig, Y.L. Chee, Y. Chen, E. Corbera, F. Lecocq, W. Lutz, M.S. Muylaert, R.B. Norgaard et al. 2014.

- 'Sustainable Development and Equity', in O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier et al. (eds), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 1–11. Cambridge, United Kingdom, and New York, NY: Cambridge University Press.
- Government of Himachal Pradesh (HP). 2009. 'Shimla Declaration', State Centre on Climate Change, 30 October. Available at <http://hpccc.gov.in/shimlaDeclaration.aspx>; accessed on 2 November 2013.
- Government of Himachal Pradesh (HP) and Leadership for Environment and Development (LEAD), India. 2009. 'Himalayan Chief Ministers' Conclave on Indian Himalayas: Glaciers, Climate Change and Livelihoods', Lead India Proceedings, Shimla, 29–30 October. Available at <http://shaktifoundation.in/wp-content/uploads/2017/06/LEAD-India-2010-Himalayan-Chief-Ministers-Conclave-Proceedings.pdf>; accessed on 2 November 2013.
- Government of Odisha, Department of Energy. 2011. "Notification" to Constitute a Climate Change Action Plan Cell and a Monitoring and Advisory Committee', *Odisha Gazette*, 16 December; accessed on 14 October 2013.
- Government of Sikkim. 2009. "Notification", to Rename the Department of Science and Technology', *Sikkim Government Gazette*, 26 October; accessed on 2 November 2013.
- . 2011. 'Sikkim Action Plan on Climate Change (2012–2030)', Gangtok. Available at <http://envfor.nic.in/downloads/public-information/Sikkim-SAPCC.pdf>; accessed on 11 October 2013.
- Housing and Environment Department, Government of Madhya Pradesh (MP). 2012. 'Madhya Pradesh State Action Plan on Climate Change', Bhopal. Available at http://www.epco.in/pdf/Draft_MP_SAPCC.pdf; accessed on 8 November 2013.
- Mani, Muthukumara. 2010. 'The Little State That Could', *World Bank Blogs*, 15 June. Available at <http://blogs.worldbank.org/endpovertyin-southasia/little-state-could>; accessed on 11 July 2012.
- Ministry of Environment and Forests (MoEF). 2010a. 'Summary of Discussion: National Consultation Workshop on Preparation of State Level Strategy and Action Plan on Climate Change', New Delhi. Available at <http://www.moef.nic.in/downloads/others/SAPCC-workshop-summary-2010.pdf>, accessed on 10 July 2012.
- . 2010b. *A Framework for Preparation of the State Level Action Plans on Climate Change*. New Delhi: Ministry of Environment and Forests, Government of India.

- _____. 2014. 'State Action Plan on Climate Change', New Delhi. Available at <http://envfor.nic.in/ccd-sapcc>; accessed on 20 October 2014.
- Ogra, Anshu. 2013. 'A Study of Climate Policy Integration in the State Action Plans on Climate Change', Background Paper for the Centre for Policy Research, New Delhi.
- Press Information Bureau. 2009. 'PM's address at the National Conference of Ministers of Environment and Forests', 18 August. Available at <http://pib.nic.in/newsite/erelease.aspx?relid=51926>; accessed on 10 July 2012.
- Press Trust of India. 2009. 'World Bank to Help Himachal Become Carbon-neutral State', *DNA*, 14 November. Available at <https://www.dnaindia.com/india/report-world-bank-to-help-himachal-become-carbon-neutral-state-1311648>; accessed on 10 December 2014.
- _____. 2011. 'Himachal Inks Pact with World Bank to Secure Carbon Credits', *The Hindu*, 23 May. Available at <http://www.thehindu.com/todays-paper/tp-national/himachal-inks-pact-with-world-bank-to-secure-carbon-credits/article2041233.ece>; accessed on 2 November 2013.
- Prime Minister's Council on Climate Change (PMCCC). 2008. 'National Action Plan on Climate Change', Government of India, New Delhi, pp. 1–49. Available at <http://www.moef.nic.in/downloads/home/Pg01-52.pdf>; accessed on 10 December 2014.
- Schreurs, Miranda A. 2008. 'From the Bottom Up: Local and Subnational Climate Change Politics', *Journal of Environment and Development*, 17(4): 343–55.
- Tambe, Sandeep and M.L. Arrawatia. 2012. *Climate Change in Sikkim: Patterns, Impacts and Initiatives*. Gangtok: Information and Public Relations Department, Government of Sikkim.

State Climate Change Planning

Has It Reached the Mainstream?

Elizabeth Gogoi

In 2009, the prime minister of India asked all state governments to prepare State Action Plans on Climate Change (SAPCCs) in an effort to help implement the National Action Plan on Climate Change (NAPCC). Since the process of drafting the SAPCC was rolled out across the country, states have moved forward with varying levels of motivation and speed. Some took many years to finalize and adopt it (for example, Maharashtra only formally adopted their SAPCC in 2017, after starting the process in 2010), while others (for example, Odisha) are already finalizing a second version. By 2017, the National Steering Committee on Climate Change had approved climate plans from 32 states and union territories and attention has since shifted to implementing (and updating) the plans.

This chapter aims to explore what steps the state governments have taken since the SAPCCs were first drafted to shed light on the potential and challenges of state climate change planning. It focuses

primarily on adaptation planning, drawing out trends in terms of what different states are doing and the challenges they face, while recognizing that it is impossible to generalize across all 29 states in India. It uses specific examples from six states, namely, Assam, Bihar, Chhattisgarh, Kerala, Maharashtra, and Odisha, which are part of the 'Action on Climate Today' (ACT) programme which uses the SAPCC as the starting point to support climate change planning, and with which the author is involved.¹

Evolution of the Concept of State Climate Change Planning in India

State climate change planning is a broad and potentially all-consuming term: it could cover many sectors, multiple levels of sub-national government, and be mitigation or adaptation focused, or both. However, since 2008 and the NAPCC, the Ministry of Environment, Forest and Climate Change (MoEFCC) and most state governments appear to equate climate planning, and in particular SAPCCs, with adaptation planning. There is very little state planning underway on reducing greenhouse gas (GHG) emissions per se, and mitigation policy is being driven centrally by the NAPCC. State governments are putting in place plans and policies to promote renewable energy and energy efficiency, but this is primarily driven by the associated economic and development benefits and has typically not been tied to a climate governance process. There was some confusion about whether SAPCCs were originally intended to include mitigation actions, but, in practice, most plans focus primarily on adaptation (Dubash and Jogesh 2014).

State governments drafted their SAPCC with the understanding (or assumption) that they would receive central government

¹ The ACT programme (2014–19) is a United Kingdom (UK) aid funded technical assistance programme in South Asia being managed by Oxford Policy Management (OPM), in collaboration with a number of national and state partners. In India, the programme is called the 'Climate Change Innovation Programme' and supports six state governments to mainstream adaptation to climate change within systems of development planning and delivery.

funding to implement it and, as such, the plans were conceived as a set of fundable projects—often reading more like a ‘wish list’ (Kumar 2018). Although the National Adaptation Fund on Climate Change (NAFCC) was established in 2015 with the idea of funding some SAPCC actions, it is not at the scale that was expected. For example, the entire budget provision of Rs 350 crore (50.46 million USD as per present exchange rate) for 2015–17 would cover only a single year of Kerala’s planned activities, and even less of other states (Allen et al. 2016).

By 2015, the central government had settled on the idea of SAPCCs as frameworks for ‘mainstreaming’, meaning integrating climate change risks and opportunities within existing and new development policies, plans, programmes, and budgets. This pushed the responsibility for funding the SAPCCs back to the states. India’s Nationally Determined Contribution (NDC) clearly states that 32 states and union territories have put in place SAPCCs, ‘attempting to mainstream climate change concerns in their planning process’ (Government of India [GoI] 2016). In reality, most of the plans are a mix of proposing new stand-alone ‘projects’ as well as guidance to line departments on what climate change risks their sector faces, and what possible actions could be taken (Dubash and Jogesh 2014; Gogoi 2015).

The evolving concept of state climate change planning in India has led to some confusion and different interpretations of what constitutes implementation of state climate change plans. The rest of the chapter will explore whether and how implementation of SAPCCs has occurred and the challenges surrounding it.

Status of Implementation of SAPCCs

For the purpose of this chapter, I define implementation of SAPCCs as their impact on line departments to take forward the recommendations in the plan and take new actions to integrate climate change risks within their ongoing and planned work. In other words, the extent to which SAPCCs have adjusted the business-as-usual approach to development. This is very difficult to monitor and report on, and little formal data exist on the extent of implementation. Anecdotally, Odisha is one state that attempted reporting on implementation of

the SAPCC, but without distinguishing whether the line department was anyway planning or delivering the adaptation action prior to the SAPCC.

An annual, internal context assessment within each of the six ACT states suggests that there are very few examples of an obvious direct link between the SAPCC and a line department independently taking up a new recommendation in the plan (ACT 2017; Gogoi 2017). However, in a number of states, the SAPCC has had a role in facilitating new action on adaptation. For example, in Assam, the process of finalizing and adopting the SAPCC in 2015 (and the new opportunity for financing from the NAFCC) spiked government interest, leading to some new policy initiatives. An illustration being that the SAPCC highlighted that the State Water Mission was pending since 2008, and so the government restarted the process with a specific consideration on climate change.

In many cases the SAPCC has, however, provided a structure and mandate for donor-funded programmes on climate change. Bilateral donors and partners—UK Department for International Development (DFID), Swiss Agency for Development and Corporation (SDC), and the German development agency, GIZ, in particular—agreed with the MoEFCC to support the implementation process and most states are now in some way being supported by technical assistance programmes from one of these agencies. For example, with technical support from such programmes, the Government of Maharashtra has prioritized the recommendations within the SAPCC, and prepared sectoral action plans which are a mixture of new projects and plans and modifying existing ones. The aim of this intervention is a more visible implementation of the SAPCC.

Evidence of Efforts to Mainstream Climate Change within Wider Development Planning

There is, however, significant evidence of states planning and implementing adaptation actions not directly linked to SAPCCs—meaning the actions were either not listed in the SAPCC or were listed but this was not the motivating factor (ACT 2017; Gogoi 2017).

States have chosen different and various entry points for mainstreaming climate change into their development policies and plans. Some states have integrated climate change into broad sectoral strategy or vision documents, a relatively easy entry point as there is no direct link to budgets, nor immediate pressure to implement (Gogoi, Bahadur, and Rumbaitis 2017). For example, the Government of Bihar in 2017 adopted an agriculture road map, which explicitly considers climate information and the implications for future agriculture productivity in the state. Some states have also mainstreamed climate change within flagship programmes, which can be a more difficult process but tends to have a more direct impact on budget and action on the ground. For example, in Chhattisgarh, the Department of Panchayat and Rural Development is looking at how the infrastructure built through Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) can provide additional adaptation benefits to the local communities.

While these examples are mostly one-off efforts at mainstreaming, there are initiatives to integrate climate change within regular systems of state planning and delivery. For example, in Kerala, the State Planning Board included climate change as a new cross-cutting theme within the District Plan (2017–22)—a guideline for the annual planning process of different tiers (district, block, gram) at the district level. There is also an evolving policy, planning, and institutional architecture for disaster risk reduction at the state and district levels. The State and District Disaster Management Plans, to different extents, incorporate climate change information and concerns, although there are efforts underway to make these plans explicitly climate-smart (Gupta et al. 2016).

Importance of Local Factors Shaping State Climate Change Planning

The examples of state climate change planning listed in the previous sections—both directly tied to implementation of the SAPCCs as well as wider efforts at mainstreaming underway—were motivated and influenced by different and varied local factors. Climate planning has happened in certain states and sectors, and not others, due to differences in the priorities, interests, and commitment of local

decision makers, as well as the wider institutional and governance context (Gogoi, Bahadur, and Rumbaitis 2017). This section uses examples from across different states to highlight some of the key governance-related challenges to climate change planning, and where state governments and other stakeholders are innovating to try and find solutions.

Political Ownership of the SAPCC

The SAPCCs in many states are often not fit for purpose in guiding line departments on where and how to take action on climate change. Most suffer from the legacy of their drafting process and the lack of ownership across the government, as well as the quality of the content of the plan (see Chapter 20 in this volume). However, in many states, the SAPCCs have facilitated, for the first time, a discussion on the relevance of climate change for the state. There has, therefore, been an indirect benefit from the SAPCCs of increasing state government officials' level of understanding and awareness of climate change risks and making them more interested and receptive to opportunities for mainstreaming climate change.

Some governments are being proactive in strengthening the policy framework. The Government of Kerala is currently reviewing its SAPCC and updating it to be more focused and implementable. In Assam, a draft version of the plan was lying dormant for a few years, until an enterprising government official and a committed chief secretary got it redrafted, and adopted, in a matter of months, and it has been a catalyst for a number of institutional and policy initiatives. In Maharashtra, the plan was too broad and unfocused, and there was little government commitment to it. In 2017, the government used it as a basis for prioritizing a set of adaptation actions within the first-ever State Climate Change Policy. In all these cases, the government recognized the value of having a guiding policy framework, although they were motivated by different interests, and all had significant external technical support.

In the next few years, states will likely be required to report upwards on adaptation for both Sustainable Development Goals (SDGs) and NDC processes. If SAPCCs are used as the basis for

this reporting, the level of interest and ownership in them could improve significantly. If they are ignored, then their relevance will be further eroded.

Convergence with Political Priorities of the State

The interests and incentives—and relative power—of different decision makers within a state defines the extent and type of political will that exists to tackle climate change. For many state governments, tackling or managing the particular climate change risks that they face is one of their highest political priorities (for example, tackling the increasing occurrence and severity of floods in Assam), and there is a very high level of understanding across the bureaucracy on the complicated set of contributing factors and possible solutions. There is, therefore, a political appetite for tackling climate change if it is presented in terms of tackling the most visible climate change risk facing the state.

Climate change, as a general issue in itself, is often still seen as a distant scientific issue and primarily an international concern, although with associated opportunities for accessing climate finance. In the last couple of years, the NAFCC and the Green Climate Fund (GCF) have caused a spike in interest within many state governments, and the process of preparing the project proposals has, to a certain extent, helped reconcile climate change as an issue with their political priorities. Preparing funding proposals has required many state departments to articulate the adaptation co-benefits of their existing development priorities.

In addition to political priorities, the informal cultures and values of a state or region are also significant. For example, in Kerala, there is a history and culture of 'environmentalism', with an active civil society, which survives successive changes in the ruling party. To a certain extent, this is a positive starting point for climate change planning, but also poses a challenge. The prevailing narrative of the government and society is around environmental conservation and 'green' development and over the last decade, climate change has been added to this agenda without sufficient discussion and clarity on what is different between tackling climate change and protecting the environment.

Confusion About How Climate Change is 'Different'

Across nearly all stakeholders—governments, private sector, academics, non-governmental organizations (NGOs), consultants, and others—there is still confusion about the difference between 'good' development and adaptation. For example, is an irrigation project always considered to be contributing to adaptation? The experts on adaptation have not clearly articulated what counts as adaptation to state governments and others (Bird et al. 2012). The national and international climate funds available require funding proposals to articulate to a certain degree how the proposed project provides additional adaptation benefits (as opposed to development benefits); however, there is little guidance for doing this. The funding will cover the entire cost of the project, rather than just the extra cost of the additional adaptation benefits. If the goal is to mainstream climate change within development plans and investment, then it seems crucial that stakeholders can identify the different multiple benefits that a single project or programme can deliver (Fayolle and Oodianose 2017).

Some state governments have started to review and track their level of expenditure on adaptation within their ongoing development programmes (Resch et al. 2017). For example, in 2017, the Bihar deputy chief minister released a report which analysed and scored a number of government programmes and schemes on the extent to which they were providing adaptation benefits (as compared to the other types of benefits they were providing, such as economic, social, and environmental). This benefits-based methodology compares the benefits delivered by an action if there was no climate change (that is, the development benefits) with the benefits if it does happen (that is, the benefits increase—or decrease for cases of maladaptation) (Resch et al. 2017). This is useful for clarifying the additionality of tackling climate change (see Chapter 22 in this volume), but the work is at the early stages and reliant on external technical support.

Institutional Capacity for Climate Change Planning

There has been some expansion in the institutional capacity of some state governments for climate change planning. The process of designing the SAPCC as well as developing funding proposals for

the NAFCC and global climate funds, and more recently discussions around the SDGs, have had a number of indirect benefits in terms of establishing institutional mechanisms for managing climate change risks. In different states, the SAPCC process has resulted in at least one of the following: nodal agencies or cells for climate change (for example, in Kerala); knowledge management centres focused on climate change (for example, in Chhattisgarh); climate change focal officers sitting in different line departments (for example, in Assam); and cross-sectoral coordination committees on climate change (for example, in Maharashtra). They vary widely in terms of the level of effectiveness and sustainability, but all tend to aim for facilitating and coordinating adaptation planning across departments.

There are different models and approaches to creating institutional capacity for managing climate change. In most cases, the nodal agency is located within the environment or forestry departments, which are relatively weak and struggle to facilitate action by other departments. In Assam, the government is trying to overcome this by establishing an Assam Climate Change Management Society (ACCMS), which operates as a special purpose vehicle (SPV) for coordinating climate change planning across departments, and can also receive and manage climate funds. The ACCMS, and the more typical Climate Change Cells located within the environment or forestry departments, all rely on the chief secretary and/or political leadership to provide the high-level backing to their coordination mandate. Similarly, coordinating committees have only proven to be productive (and survive beyond their initial mandate of overseeing the drafting of the SAPCC) if there is senior leadership participation and commitment. There are also questions around whether these mechanisms will become truly embedded within the institutional structures and live beyond the technical assistance programmes which are often, to different degrees, propping them up.

This chapter provides a brief overview of the status of climate change planning across different states in India, highlights some of the challenges, and discusses experimentation with different approaches. There remains confusion over the purpose and role of SAPCCs,

although the opportunity of accessing NAFCC funding and the involvement of donor-funded programmes have sustained a focus on them. There is also mainstreaming of adaptation within development planning and programmes taking place that is not directly tied to the SAPCCs, as well as efforts to build institutional capacity.

There are valid questions around whether recent progress on climate change planning will be sustained once the current batch of donor-funded programmes, focused on cross-sectoral climate change planning, come to an end. However, international climate funds are expected to continue, which will require states to maintain a focus on adaptation planning, as will reporting on NDC and SDGs implementation. Addressing some of the critical governance challenges to climate change planning will be important to maximize these opportunities.

References

- Action on Climate Today (ACT). 2017. 'Institutional Context for Tackling Climate Change in South Asia: What Was New in 2016', Oxford Policy Management, New Delhi. Available at <http://www.actiononclimate.today/wp-content/uploads/2018/07/The-Institutional-Context-for-Tackling-Climate-Change-in-South-Asia.pdf>; accessed on 13 June 2019.
- Allen, Stephanie, Elisabeth Resch, Laura Giles Alvarez, and Kit Nicholson. 2016. *Progress with Climate Change Financing Frameworks in Selected South Asian Countries*. New Delhi: Oxford Policy Management.
- Bird, Neil, Thomas Beloe, Merylyn Hedger, Joyce Lee, Kit Nicholson, Mark O'Donnell, Sudha Goaty, et al. 2012. *Climate Public Expenditure and Institutional Review (CPEIR): Methodological Note*. New York and London: United Nations Development Programme (UNDP) and Overseas Development Institute (ODI). Available at <https://www.odi.org/publications/6191-cpeir-methodology-climate-finance-national-public-expenditure>; accessed on 13 June 2019.
- Dubash, Navroz and Anu Jogesh. 2014. 'From Margins to Mainstream? State Climate Change Planning in India', *Economic & Political Weekly*, 49(48).
- Fayolle, Virginie and Serena Odianose. 2017. *Green Climate Fund Proposal Toolkit*. London: Acclimatise and Climate and Development Knowledge Network. Available at <https://cdkn.org/wp-content/uploads/2017/06/GCF-project-development-manual.pdf>; accessed on 13 June 2019.

- Gogoi, Elizabeth. 2015. 'India's State Action Plans on Climate Change: Towards Meaningful Action', Oxford Policy Management, New Delhi, available at <https://www.opml.co.uk/files/Publications/corporate-publications/briefing-notes/bn-india-state-action-plans-climate-change.pdf?noredirect=1>; accessed on 13 June 2019.
- . 2017. 'Institutional Context for Tackling Climate Change in South Asia in 2015', Oxford Policy Management, New Delhi. Available at <https://www.opml.co.uk/files/Publications/corporate-publications/working-papers/wp-climate-south-asia.pdf?noredirect=1>; accessed on 13 June 2019.
- Gogoi, Elizabeth, Aditya V. Bahadur, and Cristina del Rio Rumbaitis. 2017. 'Mainstreaming Adaptation to Climate Change within Governance Systems in South Asia: An Analytical Framework and Examples from Practices', Oxford Policy Management, New Delhi. Available at <https://www.opml.co.uk/files/Publications/8617-action-on-climate-today-act/mainstreaming-adaptation-to-climate-change-within-governance-systems-in-south-asia.pdf?noredirect=1>; accessed on 13 June 2019.
- Government of India. 2016. 'India's Intended Nationally Determined Contribution: Working towards Climate Justice'. New Delhi: Government of India. Available at <http://nmhs.org.in/pdf/INDIA%20INDC%20TO%20UNFCCC.pdf>; accessed on 13 June 2019.
- Gupta, Anil Kumar, Sakshi Katyal, Shashikant Chopde, Shiraz A. Wajih, and Amit Kumar. 2016. 'Climate-Smart District Disaster Management Plan as Effective Tool for Implementing State Action Plan on Climate Change: Lesson from Three States in India', Gorakhpur Environmental Action Group and Institute for Social and Environmental Transition, New Delhi. Available at <https://www.i-s-e-t.org/resource-climate-smart-development>; accessed on 13 June 2019.
- Kumar, Vineet. 2018. 'Coping with Climate Change: An Analysis of India's State Action Plans on Climate Change', Centre for Science and Environment, New Delhi. Available at http://cdn.cseindia.org/attachments/0.40897700_1519110602_coping-climate-change-volII.pdf.
- Resch, Elisabeth, Stephanie Allan, Laura Giles Alvarez, and Harshita Bisht. 2017. 'Mainstreaming, Accessing and Institutionalising Finance for Climate Change Adaptation', Oxford Policy Management, New Delhi. Available at <https://www.opml.co.uk/files/Publications/8617-action-on-climate-today-act/mainstreaming-accessing-and-institutionalising-finance-for-climate-change-adaptation.pdf?noredirect=1>; accessed on 13 June 2019.

Climate Finance

Koyel Kumar Mandal

Finance for climate change-relevant activities, or climate finance, has been a central element of international negotiations on climate change. Although the actual term 'climate finance' is most often associated with the international climate change negotiations, different countries have developed their own strategies and institutional mechanisms around the access and use of climate finance, including from domestic sources. This chapter focuses on the evolution of the concept of climate finance in India, reviews India's current efforts at mobilizing finance for mitigation and adaptation from various sources, and analyses the major drivers behind the flow of such funds. Although the focus of the chapter is on the Indian climate finance landscape, it recognizes the debates around climate finance at the international level, and the challenges they pose in determining both India's requirements for as well as sources of climate finance. Next, the chapter discusses institutional arrangements around climate finance and their implications. Then, it concludes by summarizing some of the key insights that will be relevant for India from the perspective of mobilizing and delivering climate finance.

The Conceptual Foundation of Climate Finance in India

Climate finance is one of the key elements of action against climate change. Yet, there is little consensus among countries on what constitutes climate finance. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate finance as follows: 'Climate finance aims at reducing emissions, and enhancing sinks of greenhouse gases and aims at reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negative climate change impacts' (Standing Committee on Finance 2014). This definition represents climate finance in its broadest form—the flow of funds to all activities, projects, and programmes that address climate change, whether mitigation or adaptation, anywhere in the world. However, even in this broad form, there is no consensus among all countries on the definition.

There are different variables that determine what counts as climate finance and what does not. These include: intent of financing or in other words, whether climate change is a motivating factor behind the funding; concessionality (grants, concessional loans, non-concessional loans, guarantees, and so on); source (public or private); and geographic origin (developed countries to developing countries, within developed nations, or from other sources). A further and highly difficult issue to address is the concept of 'additionality' of finance. The term 'additionality' refers to the idea that funds raised for climate change should not substitute or divert funds from other important developmental objectives, particularly social and economic development. However, determining additionality is complicated because of the inherent difficulty in establishing a counterfactual. It is hard to answer with certainty what countries would have given as development assistance in some year (say, 2030) if we had never heard of climate change. Yet, the choice of definition fundamentally affects the quantification of climate finance.

While climate finance has always been a central element of international negotiations, it is now most often associated with the target of developed countries mobilizing US\$100 billion per year by 2020 for developing countries—a step that helped unlock the Copenhagen Accord in 2009 (UNFCCC 2009). The Paris Agreement reinforces this commitment, and the

Green Climate Fund (GCF), an operating entity of the Financial Mechanism of the UNFCCC, will be a central institution to serve the Paris Agreement (Jha 2017). The GCF recognizes the need for country ownership of climate funding by allowing national institutions to access, manage, and disburse funds for climate action. National designated authorities (NDAs) act as the interface between the country and the GCF, and funding from the GCF is deployed in countries through various accredited entities—national, regional, or international (GCF 2016).

However, the landscape of climate finance is broader than just the GCF. For example, the climate focal areas of the Global Environment Facility (GEF), the Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF), and the Adaptation Fund (AF) disburse around less than US\$ 1 billion per year (Ministry of Finance [MoF] 2013). In addition, there are also funds administered by the World Bank, Asian Development Bank, among others, with clear climate change components, as well as official development assistance (ODA) targeting climate change adaptation and/or mitigation flowing through bilateral channels.

There is concern within the Government of India (GoI) that the developed countries are going back on their climate finance commitments. Specifically, there are concerns that climate finance flows do not capture climate finance arrangements as reflected in the articles of the UNFCCC, which direct developed countries to provide new and additional financial resources to meet the agreed-upon full incremental costs of climate change measures to be implemented by developing countries (MoF 2014). Different studies compile estimates from disparate sources using different assumptions and methodologies, and country positions on what counts as climate finance and what does not often vary depending on whether the country is a provider or recipient of funds.

In response to an Organisation for Economic Co-operation and Development (OECD) report that estimated that climate change finance from developed to developing countries had reached US\$ 62 billion in 2014 and US\$ 52 billion in 2013, the GoI came out with a discussion paper that strongly contested the OECD figures on primarily four counts (Dasgupta, Rajasree Ray, and Singh 2015). First, the MoF paper argues that climate finance has to be

additional, and therefore claims that only finance flowing from dedicated climate funds should be counted. Second, it argues that only disbursed funds, and not pledges and commitments, should be counted. Third, the paper argues against 'self-tagging' of projects by multilateral development banks (MDBs) and official aid agencies using methods such as the Rio markers and counting them towards climate finance. Finally, the paper argues that only the grant equivalent element of any claimed climate change financing, not the gross face value of all loans, guarantees, export credits, and other elements, should be counted. In terms of private finance, the paper calls for a distinction between climate-related investments and business-as-usual (BAU) investments, and claims that only new and additional need-based finance should be counted. India's convictions on the various determinants of international climate finance are, therefore, quite clear: such finance should be motivated by climate change concerns; it should be in the form of grants and preferably from public sources; and finally, climate finance should be new and additional.

While India is a strong advocate of additionality in international climate finance, it has been quite inconsistent in the application of the same principle when it comes to domestic climate finance. An MoF paper estimated that the annual government expenditure in India on adaptation to climate variability exceeds 2.6 per cent of the gross domestic product (GDP) (Climate Action 2012). The entire budget for a large number of ongoing developmental schemes that were in place even before India's National Action Plan on Climate Change (NAPCC) was announced was counted as adaptation spend in this study. In fact, the *Economic Survey 2011–12*, which for the first time included a chapter on 'Sustainable Development and Climate Change' with a dedicated section on 'Climate Change Finance', articulates climate finance in the context of India's need for funds and technology to finance domestic actions to address climate change and achieve sustainable development (MoF 2012).

This is also reflected in the way climate actions have been financed in India, mostly as sectoral finance in the form of government budgetary support, since some of the resources for adaptation and mitigation are built into the ongoing schemes and programmes. In case of the national 'missions', sometimes there have been dedicated budgets allocated to the ministries and departments, which are the

executing agencies of these missions, whereas, on a number of occasions, the missions had to be accommodated within the existing government programmes and schemes (Singh 2017).

However, the National Adaptation Fund for Climate Change (NAFCC), a flagship scheme of the union government launched in 2015 to provide central grant to the state governments for implementing climate change adaptation projects, marks a departure not just in terms of the delivery mechanism for domestic climate finance but also the definition of climate finance itself. The NAFCC emulates some of the international climate finance mechanisms, with the National Bank for Agriculture and Rural Development (NABARD) as the National Implementing Entity (NIE) and the activities under this scheme implemented in project mode. All project proposals require a justification framed in terms of BAU development for the targeted sector and the specific adaptation activities to be implemented to reduce climate change vulnerability compared to the BAU situation.

A review of the 21 Detailed Project Reports (DPRs) that were sanctioned in 2015–16 and 2016–17 reveals that the section on ‘project justification’ is either inadequate or simply mentions that information on BAU will be ascertained once the project is implemented. Some of the DPRs, such as the one for West Bengal, point to a huge developmental deficit that is exacerbated by the impacts of climate change. However, the cost estimates do not attempt to calculate the additional costs because of climate change. This underscores the difficulty in operationalizing the concept of ‘additionality’, something that plagues the discourse on international climate finance as well. What meanings can, therefore, be attached to additionality of climate finance relative to development finance?

Some experts have argued that a radical separation of finance for development and climate finance could be damaging, and that climate and development needs should be mainstreamed where possible in order to maximize the impact of the funds (Stern 2015). If there are relatively limited actions that are motivated only by climate and not by development, designing climate action, and finance for that action, around the Sustainable Development Goal (SDG) strategies and finance could foster the strongest climate benefits, whilst, at the same time, enhancing developmental benefits. The SDGs also

clearly and strongly recognize the importance of climate change in particular, and sustainability in general. Goal 13 is on climate action and states explicitly, ‘take urgent action to combat climate change and its impacts’, whereas the word sustainable appears in 11 of the 17 goals (Stern 2015). Indeed, poverty reduction, growth, and development are intricately linked with climate change.

India’s Current Climate Finance Landscape: Needs, Drivers, and Sources

There are numerous estimates of India’s climate finance needs, but interpreting those numbers is difficult primarily because of three issues. First, there is a conceptual lack of clarity on the definitional aspects of climate finance, particularly the concept of additionality, which likely seeps into estimates of financing needs. For example, the first articulation of domestic requirements for climate finance is found in the *Economic Survey 2012–13*, which estimated Rs 230,000 crore (Rs 2,300 billion) as the amount of finance needed to fulfil the mission objectives under the NAPCC (MoF 2013: 264). The emphasis of the national missions is on sustainable development, with climate change adaptation and mitigation as co-benefits. In contrast, the Planning Commission report estimating the total cost to the Indian economy of low-carbon strategies as US\$ 834 billion (in constant 2011 dollars) over 20 years from 2011–30 (Planning Commission 2014) is a measure of the opportunity cost to the economy for following a low-carbon growth pathway. Further, India’s Nationally Determined Contribution (NDC) states that according to preliminary estimates, at least US\$ 2.5 trillion (at 2014–15 prices) will be required for meeting India’s climate change actions between 2015 and 2030 (Ministry of Environment, Forest and Climate Change [MoEFCC] 2015: 31). However, based on the document, it is quite unclear how this number was arrived at.

Second, there is a lack of any citation on the methodology for coming up with any of these estimates. For example, an independent evaluation of India’s NAPCC mentions that it is unclear how numbers were arrived at for the financial estimates for some of the missions (Byravan and Rajan 2012). According to another study assessing the State Action Plans on Climate Change (SAPCCs), there are marked

inconsistencies in the estimates quoted by different states, as well as a lack of objective criteria in determining the prioritized list of actions (Mandal, Rath, and Venkataramani 2013: 16).

Third, all these estimates have been done in different contexts. For example, the Economic Survey is a key government document that is used for the preparation of union budgets and, therefore, reflects the need for domestic resources to implement various plans and programmes. In contrast, India's Intended Nationally Determined Contribution (INDC) was a document submitted to the UNFCCC in the context of a negotiation, before the 21st Conference of the Parties (COP 21) in Paris. India's NDC is conditional, implying that the achievement of some of the targets is subject to the provision of international climate finance.

It is inherently difficult to compare these different cost estimates because of their varying metrics. However, since these are all official estimates, having some conceptually consistent formulation is a part of the government's job.

There have been various efforts to map India's current sources and quantum of funds flowing into climate change activities. Figure 22.1 tries to collate information from some of these published reports and presents them in the format used in the 'Global Landscape of Climate Finance' (Buchner et al. 2017). Notwithstanding the methodological and data challenges mentioned earlier, and the fact that the numbers span different time periods, there are some insights that can be drawn from India's current climate finance landscape.

Domestic public finance represents the largest source of climate expenditure in India and most of it is in the form of budgetary support for climate-relevant government programmes. The bulk of this domestic budgetary support goes towards funding programmes relevant to climate adaptation. Yet, a larger share of the overall climate finance in India goes towards climate mitigation. This is because international climate finance is skewed towards mitigation and private finance for adaptation is insignificant. Although this may change in the future, especially because of increased focus on adaptation in international climate negotiations, given India's vulnerabilities to climate change and the uncertainties involved with international public funds, domestic spending from budgetary sources is likely to remain the major source of adaptation funding.

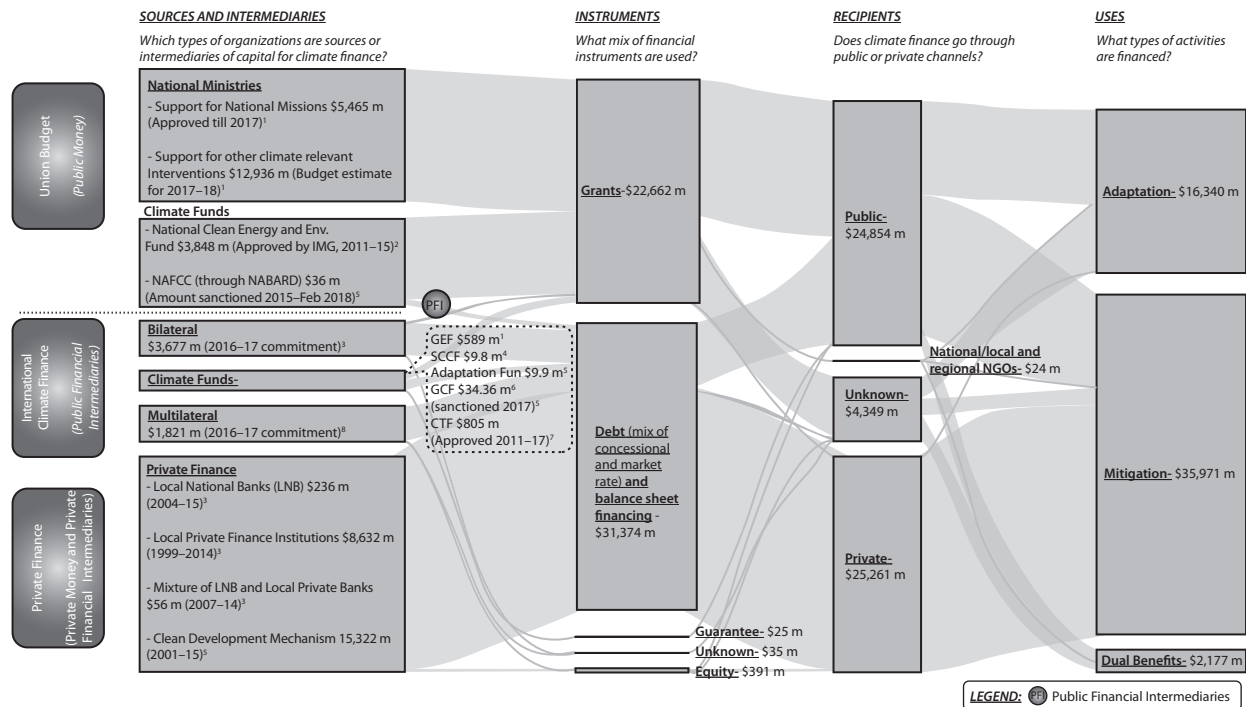


Figure 22.1 Landscape of Climate Finance in India

Sources: ¹ Singh (2017). ² Department of Expenditure (2017). ³ MoEFCC (2018). ⁴ GEF (2016). ⁵ NABARD (n.d.a). ⁶ NABARD (n.d.b).

⁷ Climate Investment Funds (2015). ⁸ OECD (n.d.).

In absolute terms, India has got approval for over US\$1 billion from climate funds, more than any other country in the world. If bilateral and multilateral sources are included in this mix, India has received more funds from international climate finance than any of its peer countries—China, South Africa, Brazil, Indonesia, and Thailand. However, India still can make a case to improve its ability to access international climate finance because the share of international climate finance in India's overall climate spend is low compared to the other sources. Unlike China and Latin American countries such as Brazil, India is not attracting climate finance in sufficient volumes relative to the country's future adaptation and mitigation needs (Steinbach et al. 2014).

Although the discussion on international climate finance tends to focus on issues of scale, international climate finance has also played an important role in leveraging private sector financing for mitigation. Bilateral donors and multilateral institutions have supported the creation of innovative financing options for energy efficiency and renewable energy projects in India. International donor-backed dedicated credit lines have been particularly important in mobilizing domestic private sector investments in energy efficiency (Varma et al. 2015).

In addition to international climate finance and domestic climate policy, the Clean Development Mechanism (CDM) has been the most important driver for private finance in climate change in India by far. With uncertainty over the future of certified emission reductions (CERs) under the second Kyoto Protocol commitment period, new restrictions for CER trading under the European Union (EU) emissions trading system, and focus on the new private sector facility of the GCF, CDM projects have already slowed down in India and are unlikely to play a significant role in leveraging private climate finance. However, Article 6 of the Paris Agreement that deals with international cooperation has given a fillip to market mechanisms (UNFCCC 2017). Though the agreement in itself does not give details about the shape and form of the new market mechanisms, and there is ample flexibility, it does mention that parties could pursue voluntary cooperation in the implementation of their NDCs to allow for higher ambition in their mitigation and adaptation actions. However, it also mentions that any such cooperative approach aimed at emission mitigation should foster sustainable development.

Despite large private investments in mitigation, the private sector has not been effectively engaged in India's climate policy formulation (Varma et al. 2015). India's official stance has always been that though alternative sources, including the private sector, can be explored to fill the gaps between the demand and supply of climate finance, public finance, with its predictable and reliable flow of funds, should be at the core (MoF 2012). The private sector is envisaged as having a greater role in climate mitigation projects where there is a potential for return and profits, as compared to adaptation projects where markets for such goods and services are either absent or unclear.

However, it is important to note that SDG 7 deals with ensuring universal clean energy access and is one of the areas where climate finance can help meet the SDGs; here, private investments will likely have an important role to play. Further, private investments in adaptation-related sectors are picking up. The recently published report, *Bonds and Climate Change: The State of the Market* (Climate Bonds Initiative 2017), found that water is the fourth-largest theme with US\$32 billion outstanding, and over a third of this was issued as labelled green bonds. Water bonds fit broadly into four categories: water treatment; flood protection and defences; conservation and restoration; and general climate resilience. This is particularly relevant for India since corporate social responsibility is now an integral part of most Indian businesses.

Overall, India has been able to draw and leverage funds for climate change from a variety of sources. The quantum of funds, however, is inadequate given the large requirements. Clear policy signals in alignment with the NDCs and balancing of funds between mitigation and adaptation needs will be important areas of concern going ahead.

Institutional Mechanisms and Implications for Scaling Up Climate Finance

The institutional arrangements for the delivery of climate finance in India have seen a marked shift over the years. Such arrangements have mostly come up as a response to specific climate policies and funding opportunities, and there has never been a formal coordination mechanism for climate finance. Although some experts, including

the MoF itself, have advocated for the creation of a national green/climate fund (MoF 2013: 264–5; Steinbach et al. 2014), others have argued that the creation of a domestic fund will not in and of itself solve issues around the need for better coordination (Jha 2014). Currently, climate finance in India flows through multiple actors and channels, and a variety of institutions, both public and private, are involved in the delivery of funds. While this may not necessarily be a problem for a diverse and decentralized country such as India, the salient question is whether the current institutional mechanism is effective enough to deliver the transformational change that India needs.

It is quite evident from the previous section that India's requirements for climate finance are large and it needs to substantially scale-up existing finances to be able to meet its needs. Most of the domestic as well as international funding labelled as climate finance has come in the form of small projects, and these are unlikely to have a transformational impact on India's development path, as may be needed to deal with climate change. Instead, such efforts need to be integrated with larger policy processes such as the national missions and SAPCCs. This integration would allow India's policy vision and implementing institutions to effectively blend domestic and international climate finance (Jha 2017). The only instance where India has been able to access a significantly large funding has been in the case of the Clean Technology Fund (CTF). However, this was largely because of the efforts of the World Bank and Asian Development Bank brokering India's investment plan in an attempt to support their existing efforts and maximize the financial gains from accessing the CTF (Jha 2014).

This also begs the question of whether domestic actors in India's climate finance landscape have the capacity to effectively access and deliver climate finance. Indian states are at the forefront of implementing climate change activities. While the national missions are funded through budgetary outlays to the nodal ministries that are in charge of the respective missions, the state departments are indirect recipients of such funds through their central counterparts. With the formation of the NAFCC, states can now also directly access funds to implement climate adaptation projects. States are also recipients of climate finance from bilateral and multilateral sources. The other

prominent domestic actor in India's climate finance is NABARD, owing to its accreditation as NIE for three funds, namely, NAFCC, AF, and GCF.

There are capacity constraints both with Indian states as well as NABARD. The SAPCCs were prepared with support from international agencies, such as the United Nations Development Programme (UNDP) and the German aid agency, GIZ (Dubash and Jogesh 2014). A review of the approved DPRs submitted by the states to the NAFCC reveals that most of them were prepared with support from the same international agencies. Similarly, four out of the five proposals submitted by NABARD to the AF have come through pilot projects carried out with the financial and technical support of GIZ (Jha 2014). This is particularly relevant given that India has been a strong proponent of direct access and greater country ownership, arguing for GCF-funded activities to be conceptualized, initiated, and owned by the developing countries in a manner consistent with its national climate change strategies and action plans (MoF 2013).

The story is not very different in case of large developmental programmes with climate co-benefits. Despite the fact that domestic public finance represents the largest source of climate spending in India and most of it is in the form of budgetary support for climate-relevant government programmes, there is limited effort to design interventions that have stated multiple objectives, such as poverty reduction, economic growth, and climate change. For example, several studies and government documents have pointed out that the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), one of the largest social protection schemes in the world, leads to reduction in vulnerabilities of rural population and has the potential to deliver climate resilience at scale (MoEFCC 2015; Tiwari et al. 2011). However, climate change does not appear as one of the stated objectives of the Act or any of its guidelines. The only conscious effort to mainstream climate change in MGNREGA has been through a bilateral cooperation project, 'Infrastructure for Climate Resilient Growth (ICRG)', with the Ministry of Rural Development, GoI, and supported by the International Climate Fund of the United Kingdom (UK) government (ICRG n.d.).

Financial institutions, such as public and private sector banks, government-backed non-banking financial companies (NBFCs),

private NBFCs, and so on, are the other important set of stakeholders in the Indian climate finance landscape. The majority of private finance in climate change, as mentioned earlier, comes in the form of investments in energy efficiency and renewable energy projects (Varma et al. 2015). Some of it is investments that would have happened in a BAU scenario, while the rest is leveraged through policy incentives and international and domestic climate finance. The Indian private sector is also showing an interest in directly accessing international climate finance. Yes Bank and Infrastructure Leasing & Financial Services Limited (IL&FS), for example, are two private sector corporations that have applied for accreditation as NIEs for the GCF. While the private sector is expected to bring in innovation and efficiency in the access and delivery of climate finance, it will be driven by profit motives, and it is therefore important to ensure that national development priorities are aligned with private sector interests. The CDM is one such example where the Indian private sector has been successful in leveraging huge investments in mitigation, but it has been criticized for neglecting sustainable development benefits (Bose et al. 2014).

India has argued for a development-first approach to climate finance, yet it has failed to demonstrate such an approach to achieving multiple goals of development and climate change—one that fully realizes and utilizes the multiple institutional arrangements that exist in the country. It is perhaps here that the need for central coordination will be extremely important. The MoEFCC coordinates all climate change policies and programmes in India. It also serves as the nodal point for coordinating the activities of the international climate funds in India. It is the NDA for the GCF as well. Given its broad mandate, the MoEFCC must, therefore, create conditions to support the various domestic processes so as to create a new pipeline of domestically owned projects that collectively add up to transformational potential (Jha 2017).

If climate finance and development finance are indeed inseparable, it makes sense to maintain and strengthen the existing delivery mechanisms. Currently, much of India's focus is on creation of new funds and accreditation of local institutions to the GCF. Experience with dedicated climate funds, especially the National Clean Energy and Environment Fund (NCEEF) that is managed by an

inter-ministerial group, is not too encouraging. The NCEEF has not been able to disburse money effectively and, in fact, most funds have been used to finance the national missions and routine activities of the MoEFCC and Ministry of New and Renewable Energy (MNRE) (Centre for Budget and Governance Accountability [CBGA] 2012). Also, while national ownership is important, mere accreditation as an NIE does not equip an institution with the capacity to access and manage funds effectively. What is more important for India right now is to coordinate the multiple actors and channels in order to align national priorities and domestic finance with the mandates of international climate funds and secure finance at scale.

Despite years of work both at international negotiations as well as by researchers and think tanks, there is no consensus on the definition of climate finance. India's own understanding of climate finance has evolved over the years and there seems to be a disconnect between the way it articulates the concept domestically and internationally. Whereas India is firm in its stand on the concept of additionality in defining international climate finance, domestically, it has articulated climate finance in the context of sustainable development. While this may sound natural from a negotiating perspective, it has implications on India's climate finance needs and how it delivers climate finance on the ground.

There are methodological issues in estimating needs and tracking of funds. However, it is clear that the requirements are large and current funds are insufficient. India has been categorical that achievement of its climate goals relies on international finance. Although India has been successful in its efforts to access international climate finance, the volumes are low compared to overall needs and most of it has been in the form of small projects. Private finance has also contributed significantly in the energy efficiency and renewable energy sectors, and this has been driven primarily by domestic and international policies and incentives.

Given that uncertainty around international climate finance will likely remain and the fact that private sector is driven by profit motives, it is important to blend different sources of finance with

domestic priorities such as those articulated in the national missions and flagship developmental schemes. Currently, there are multiple institutional mechanisms and a variety of actors that access climate finance from different sources. The key challenge from India's perspective will be to coordinate these multiple actors and channels, and enable them to integrate with larger policy processes in order to secure and deliver climate finance that serves India's interests and is truly transformational in its impact.

References

- Bose, Subrata, Enrico Rubertus, Kundan Burnwal, Ashish Chaturvedi, Santosh Singh, Inderjeet Singh, and Prashant V. Singh. 2014. *Carbon Market Roadmap for India: Looking Back on CDM and Looking Ahead*. New Delhi: GIZ. Available at http://mahenvis.nic.in/Pdf/Report/report_ccm_Carbon%20Market%20Roadmap.pdf; accessed on 16 September 2018.
- Buchner, Barbara K., Padraig Oliver, Xueying Wang, Cameron Carswell, Chavi Meattle, and Federico Mazza. 2017. 'Global Landscape of Climate Finance 2017', Climate Policy Initiative. Available at <https://climatepolicyinitiative.org/wp-content/uploads/2017/10/2017-Global-Landscape-of-Climate-Finance.pdf>; accessed on 26 August 2018.
- Byravan, Sujatha and Sudhir Chella Rajan. 2012. 'An Evaluation of India's National Action Plan on Climate Change', Centre for Development Finance, IFMR, Chennai. Available at <http://ifmrlead.org/wp-content/uploads/2016/05/NAPCC%20Evaluation.pdf>; accessed on 16 August 2018.
- Centre for Budget and Governance Accountability (CBGA). 2012. 'Framework and Performance of National Clean Energy Fund', New Delhi. Available at <http://www.cbgaindia.org/wp-content/uploads/2016/03/Policy-Brief-Framework-Performance-of-National-Clean-Energy-Fund-NCEF.pdf>; accessed on 16 August 2018.
- Climate Action. 2012. 'India Spending Over 2.6% of GDP to Tackle Climate Change'. Available at http://climateactionprogramme.org/news/india_spending_over_2.6_of_gdp_to_tackle_climate_change; accessed on 29 April 2018.
- Climate Bonds Initiative. 2017. 'Bonds and Climate Change: The State of the Market'. Available at https://www.climatebonds.net/files/files/CBI-SotM_2017-Bonds%26ClimateChange.pdf; accessed on 26 August 2018.

- Climate Investment Funds. 2015. 'India—CTF Programming', 26 August. Available at <http://www.climateinvestmentfunds.org/country/india/india-ctf-programming>; accessed on 23 October 2018.
- Dasgupta, Dipak, Shweta Rajasree Ray, and Salam S. Singh. 2015. 'Climate Change Finance, Analysis of a Recent OECD Report: Some Credible Facts Needed', MoF, GoI. Available at https://dea.gov.in/sites/default/files/ClimateChangeOEFDReport_0.pdf; accessed on 28 September 2018.
- Department of Expenditure. 2017. 'NCEF Brief Post BE 2017–18', New Delhi. Available at http://doe.gov.in/sites/default/files/NCEF%20Brief_post_BE_2017-18.pdf; accessed on 24 August 2018.
- Dubash, N.K. and A. Jogesh. 2014. 'From Margins to Mainstream? State Climate Change Planning in India', *Economic & Political Weekly*, 49(48): 86–95.
- Green Climate Fund (GCF). 2016. 'Countries'. Available at <http://www.greenclimate.fund/partners/countries/readiness#about-ndas>; accessed on 23 October 2018.
- Global Environment Facility (GEF). 2016. 'Country at a Glance—India', 11 March. Available at <https://www.thegef.org/country/india>; accessed on 23 October 2018.
- Infrastructure for Climate Resilient Growth (ICRG). n.d. 'About ICRG'. Available at <http://ipetechnologies.com/icrg>; accessed on 1 May 2018.
- Jha, Vyoma. 2014. 'The Coordination of Climate Finance in India', Centre for Policy Research, New Delhi. Available at <http://www.cprindia.org/research/reports/coordination-climate-finance-india>; accessed on 16 August 2018.
- . 2017. 'India's Access to International Climate Finance: Rethinking Readiness', *Economic & Political Weekly*, 52(40): 36–9.
- Mandal, Koyel, Sunanda Rathi, and Vivek Venkataramani. 2013. 'Developing Financing Strategies for Implementing the State Action Plans on Climate Change', Centre for Development Finance, IFMR, Chennai. Available at <http://indiaenvironmentportal.org.in/files/file/Developing%20Financing%20Strategies%20for%20Implementing%20the%20State%20Action%20Plans%20on%20climate%20change.pdf>; accessed on 16 August 2018.
- Ministry of Environment, Forest and Climate Change (MoEFCC). 2015. 'India's Intended Nationally Determined Contribution: Working towards Climate Justice', GoI, New Delhi. Available at <http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf>; accessed on 26 August 2018.

- _____. 2018. 'National Adaptation Fund for Climate Change', Press Information Bureau. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=176178>; accessed on 24 August 2018.
- Ministry of Finance (MoF). 2012. *Economic Survey 2011–12*. New Delhi: GoI. Available at <http://indiabudget.nic.in/budget2012-13/survey.asp>; accessed on 28 September 2018.
- _____. 2013. *Economic Survey 2012–13*. New Delhi: GoI. Available at <http://indiabudget.nic.in/budget2013-2014/survey.asp>; accessed on 28 September 2018.
- _____. 2014. *Economic Survey 2013–14*. New Delhi: GoI. Available at <https://www.indiabudget.gov.in/budget2014-2015/survey.asp>; accessed on 28 September 2018.
- National Bank for Agriculture and Rural Development (NABARD). n.d.a. 'Adaptation Fund under United Nations Framework Convention on Climate Change (UNFCCC)'. Available at <https://www.nabard.org/content.aspx?id=583>; accessed on 12 October 2018.
- _____. n.d.b. 'Green Climate Fund (GCF) Sanctioned First Ever Project of India Submitted by NABARD'. Available at https://www.nabard.org/auth/writereaddata/tender/1105170959Whats_New%20-%20updated.pdf; accessed on 12 October 2018.
- Organisation for Economic Co-operation and Development (OECD). n.d. 'Climate Change: OECD DAC External Development Finance Statistics'. Available at <http://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>; accessed on 23 October 2018.
- Planning Commission. 2014. *The Final Report of the Expert Group on Low Carbon Strategies for Inclusive Growth*. New Delhi: GoI. Available at http://planningcommission.nic.in/reports/genrep/rep_carbon2005.pdf; accessed on 26 August 2018.
- Singh, Divya. 2017. 'Climate Finance Architecture in India', Centre for Budget and Governance Accountability, New Delhi. Available at <http://cbgaindia.org/wp-content/uploads/2017/12/Climate-Finance-Architecture-in-India-1.pdf>; accessed on 26 August 2018.
- Standing Committee on Finance. 2014. *Biennial Assessment and Overview of Climate Finance Flows*. Bonn: UNFCCC. Available at http://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/2014_biennial_assessment_and_overview_of_climate_finance_flows_report_web.pdf; accessed on 23 October 2018.
- Steinbach, Dave, Adarsh Varma, Prima Madan, Ashutosh Pandey, Pallavee Khanna, and Smita Nakhooda. 2014. 'Enhancing India's Readiness to Access and Deliver International Climate Finance', Ricardo-AEA, London.

- Available at <http://shaktifoundation.in/wp-content/uploads/2014/10/India-Climate-Finance-Readiness-FINAL-30914.pdf>; accessed on 23 October 2018.
- Stern, Nicholas. 2015. 'Understanding Climate Finance for the Paris Summit in December 2015 in the Context of Financing for Sustainable Development for the Addis Ababa Conference in July 2015', Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science, London. Available at <http://eprints.lse.ac.uk/64533/1/Stern-policy-paper-March-2015.pdf>; accessed on 26 August 2018.
- Tiwari, Rakesh, H.I. Somashekhar, V.R. Ramakrishna, Indu Murthy, M.S. Mohan Kumar, B.K. Mohan Kumar, Harshad Parata et al. 2011. 'MGNREGA for Environmental Service Enhancement and Vulnerability Reduction: Rapid Appraisal in Chitradurga District, Karnataka', *Economic & Political Weekly*, 46(20): 39–47.
- UNFCCC. 2009. 'Report of the Conference of the Parties on Its Fifteenth Session, Held in Copenhagen from 7 to 18 December 2009', Decision 2/CP.15.FCCC/CP/2009/11/Add.1. Available at <http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf>; accessed on 26 August 2018.
- . 2017. 'The Paris Agreement—Main Page'. Available at http://unfccc.int/paris_agreement/items/9485.php; accessed on 23 October 2018.
- Varma, Adarsh, Emily Le-Cornu, Prima Madan, and Sanjay Dube. 2015. 'The Role of the Private Sector to Scale Up Climate Finance in India', GIZ, New Delhi. Available at <https://www.giz.de/de/downloads/giz2015-en-nama-india-private-financial-institutions-climate-finance-final-report.pdf>; accessed on 28 September 2018.

Managing the Climate Technology Transition

Ambuj Sagar

Technology has been long viewed as a linchpin of climate action, with the expectation that new and improved technologies will play a significant role in underpinning climate mitigation and adaptation actions, making them cost-efficient and effective (see, for example, Metz et al. 2000). At the same time, it also is understood that addressing the climate problem requires a significant deviation from business-as-usual practices, given the scale and scope of the transformation needed as well as the rate at which it is to happen, if we are to meet the objective of the United Nations Framework Convention on Climate Change (UNFCCC 1992).

This is particularly challenging for developing countries due to the complexities of harnessing and managing technological change and the relatively meagre resources—human, organizational, technical, and financial—often available to them. Simultaneously, these countries also have to address their urgent developmental imperatives, such as economic development, provision of basic needs, and creating/sustaining livelihoods. Furthermore, the choices regarding

technological pathways and their implementation will vary from country to country depending on their developmental aspirations, resources, and socio-political context, which means that there is no simple way forward. Thus, the topic of technology and climate change is both crucial and demanding for these countries.

This chapter begins by presenting, briefly, a perspective on managing technological change in developing countries and the kinds of resources and capabilities required to do so, juxtaposing it with the role(s) of the UNFCCC in assisting developing countries with the climate technology transition process. It then focuses particularly on India's climate and development challenges (using the energy sector as a case study) and reviews some of the major steps in recent years in addressing these challenges, including in relation to the country's National Determined Contributions (NDCs). It finally discusses some of the key issues in moving forward in a manner that allows for effective engagement with both climate and development objectives in the country (and developing countries more broadly), highlighting the role of both domestic and international actors in this process.

Understanding Technology Transitions in Developing Countries

Harnessing technologies to address mitigation and adaptation challenges in developing countries fundamentally is a process of managing rapid technological change, and doing so under adverse conditions of limited financial, technical, and institutional capabilities. Still, developing countries have no choice but to engage in this process. Doing so effectively requires a clear understanding of how to manage such change within a developing country context; it also requires a broader perspective on the global system of technology innovation, production, and diffusion.

Experience across the world in the past decades across numerous developing countries has shown that harnessing and managing technological change for achieving developmental and other national goals is a tricky process indeed. At the simplest level, it involves developing the capabilities to successfully absorb, implement, and operate or manufacture new technologies domestically. It could be,

for example, the introduction of a new process of steelmaking like electric arc furnace, a top pressure recovery turbine for harnessing the waste heat from blast furnaces, or the manufacture of a new design of gas turbine blades. This requires mastering the operations in order to optimally manage these new technologies or processes.

Over time, it is possible to deepen the understanding of these technologies/processes such that one can then begin to improve upon these technologies: at first, incrementally, and then possibly even engage in radical innovation that significantly improves on these existing technologies. In other cases, firms have built up these capabilities by participating in global value chains, enabled by vertical disintegration and globalization, where they have started with manufacture, under contract to transnationals, of specific components of a technological system (say, the display of a phone) or even the assembling of systems (such as computers) and, over time, developing design and innovation capabilities. As might be imagined, this process of technological upgradation is a slow one. In yet other cases, firms might develop organizational or process innovations, such as the Toyota production system that emerged from a particular set of national circumstances, that can offer yet another path to the development of technological capabilities.

Since firms are central actors in development and dissemination of technologies, managing the process of technological change requires the development of suitable capabilities within the firm. However, a large body of work in the last few decades has shown that the development of technological (or innovation) capabilities cannot be undertaken by individual actors by themselves. It really is a process wherein a whole host of actors—firms, academic and research institutions, government agencies, specialized consultancies, law firms, and so on—interact with each other while responding to the technological opportunities and market signals, resulting in flows of knowledge, personnel, and products. Furthermore, these actors are embedded in an institutional environment (where ‘institutions’ are seen as ‘rules of the game’, such as culture, norms, and policies) that shapes their behaviour and interactions. These ‘national innovation systems’ that enable interactive learning lie at the heart of the process of technological capability building and innovation (Lundvall 1992; Nelson 1993).

Another lesson that emerges from past experiences with successful development of national innovation capabilities is the central role of the government in guiding and shaping this process through a range of policies, including support for training of human resources and the generation of knowledge, shaping of market conditions such as development of standards, competition, and trade policies, and, in many cases, even strategically guiding the development of specific industries.

All in all, while harnessing technology can be of enormous value to developing countries to meet specific goals (such as environmental protection) or enable economic development broadly, doing so effectively requires a thoughtful approach on the part of a range of actors, as well as coordination among them, which, as it turns out, is far more difficult than it sounds.

Despite this understanding of the nuances and complexities of the process of managing technological change, many of the discussions on the issue of technology development and transfer, and efforts to promote the same, take a narrow perspective, ignoring the role of the wider set of capabilities needed for effective technology adoption and implementation (see next section; also see Haselip et al. 2015; Ockwell and Mallett 2012). This is also partly driven by what Haselip et al. (2015) refer to as ‘technocratic neoliberalism’. At the same time, the world has evolved since the UNFCCC was agreed upon: many developing countries have become major emitters as well as emerging economies that are perceived as being poised to technologically challenge developed economies, especially given the expected enormous growth in the market for climate technologies. This is leading to new forms of protectionism (Lewis 2014).

Developing countries are only a part of the globalized systems of technology development and production; in fact, the centre of gravity of this system lies in industrialized countries. It is those countries that have most of the global technological and financial wherewithal to engage in research and development (R&D), which generates new and improved technologies and reduces their costs, and to engage in early deployment that can help further reduce costs as well as the technical risk of these technologies, making them more amenable to implementation in developing countries.

In other words, the rate and the depth of the climate technology transition in developing countries is coupled to what happens in industrialized countries.

Developing Countries, Climate Technologies, and the UNFCCC

Given the importance of technology for meeting climate goals, there was a clear agreement in the UNFCCC that developed countries will help developing countries with the incremental costs and development of capacities needed for managing their climate technology transitions.

Specifically, the UNFCCC noted, in Article 4.1(c), the commitment to ‘promote and cooperate in the development, application and diffusion, including transfer, of technologies’ to mitigate greenhouse emission. It also noted:

... developed country Parties and other developed Parties included in Annex II ... shall also provide such financial resources, including for the transfer of technology, needed by the developing country Parties to meet the agreed full incremental costs of implementing measures that are covered by paragraph 1 of ... Article [4] ... (Article 4.3, UNFCCC 1992)

... [developed countries] shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and knowhow to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. [And] ... shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. (Article 4.5, UNFCCC 1992)

Despite these lofty goals, the technology issue has received only limited attention for quite some time, with much of the concrete action focusing on Technology Needs Assessments (TNAs; emerging from UNFCCC, Article 4.5) aimed at helping countries determine their technology priorities. Issues like intellectual property rights (IPRs) have often dominated the discussions without leading to productive results and if anything, maybe even distracting from a more thorough and nuanced approach on technology (see Box 23.1).

Box 23.1 Intellectual Property Rights (IPRs)

The IPR issue has been particularly polarized and polarizing in the climate arena, with many developing countries (including India) arguing for an approach to IPRs to facilitate and advance access to climate technologies through, for example, relaxed IPR regimes or funds to help make intellectual property (IP) freely available. Developed countries, on the other hand, have generally espoused a strong IPR regime for providing suitable incentive to innovators as well as facilitating technology diffusion (the assertion being that a strong IPR regime protects transferred technology); they often also suggest that technology transfer is best mediated through the market (since firms are the primary owners of IP). Such differences in perspectives emerge from different discourses on diffusion and development (Ockwell et al. 2010), and also the perceived need seen by many countries to balance the desire of meeting climate goals and the national imperative for building/sustaining an industrial base and protecting/generating livelihoods. At the same time, the mixed empirical evidence, such as the strength of the IP regime not always seen as a necessary condition for technology transfer and IPR being a barrier to technology access in some cases but not others, also leads to lack of consensus on many of these issues. Observers also have pointed out the limitations of focusing on specific issues instead of the broader process (Abdel-Latif 2015) and the range of factors that play a role in effective technology transfer (Ockwell and Mallett 2012). Developing such a broad perspective and strengthening the empirical base on IPR issues—both happening to some extent—could help a move towards a more phased and graded approaches to resolving the IPR issue (Abdel-Latif 2015) and eventually, more effective technology transfer.

Sources: Abdel-Latif (2015); Ockwell et al. (2010); Ockwell and Alexandra Mallett (2012).

The Emergence of the Technology Mechanism

It was only in 2007 that the Bali Action Plan, produced at the 13th Conference of the Parties (COP 13), emphasized the role of enhanced action on technology development and transfer as a key pillar of the process to enable the ‘full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012’ (UNFCCC 2007). Developing countries agreed

to consider appropriate mitigation actions by developing country parties, but 'supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner' (Ott, Sterk, and Watanabe 2008). This eventually resulted in the establishment of the Technology Mechanism at COP 15 (2009) as part of the Copenhagen Accord (formalized in COP 16 in Cancun in 2010).

Specifically, this mechanism envisaged the establishment of the Technology Executive Committee (TEC) as its policy arm and the Climate Technology Centre and Network (CTCN) as its implementation arm. Interestingly, India played an important role in the establishment of the CTCN through its proposal that envisaged the establishment of a global network of climate innovation centres ('CleanNet', Government of India [GoI] 2009) that took a systemic view of the technology innovation process, of the differences in the needs of different developing countries, and of the importance of developing local capacity to support and accelerate technology development, adoption, and implementation (see also United Nations Division of Economic and Social Affairs [UNDESA] 2009).¹ The TEC 'focuses on identifying policies that can accelerate the development and transfer of low-emission and climate resilient technologies' (UNFCCC TT:CLEAR n.d.) and the CTCN 'promotes the accelerated transfer of environmentally sound technologies for low carbon and climate resilient development at the request of developing countries. [It] provide[s] technology solutions, capacity building and advice on policy, legal and regulatory frameworks tailored to the needs of individual countries by harnessing the expertise of a global network of technology companies and institutions' (CTCN 2018a).

The Paris Agreement further emphasized technology as one of the means of implementation, specifically emphasizing strengthening of cooperative action, especially collaborative research, development,

¹ The concept of the climate innovation centres (Sagar, Bremner, and Grubb 2009), upon which this proposal was based, eventually indeed became the basis for a global network of climate innovation centres established by the World Bank (Sagar and Bloomberg New Energy Finance [BNEF] 2010).

and demonstration (RD&D), while also establishing a technology framework (which is yet to fully fleshed out) to ‘provide overarching guidance to the work of the Technology Mechanism’; and the Agreement also suggested some links between the Technology Mechanism and the Financial Mechanism (Article 10). Importantly, the Paris COP highlighted the continued increase in the importance of non-UNFCCC institutions and processes on technology issues through, *inter alia*, the announcement of Mission Innovation (MI), a coalition of 20 major economies that agreed to double their clean energy RD&D (MI 2018a), which is intended to reinvigorate global public energy RD&D investments and strengthen the pipeline of new low-carbon energy technologies. Notably, public energy RD&D spending—a crucial indicator of governments’ commitments to the development future climate technologies—by the major industrialized countries, which account for the bulk of the global RD&D expenditures, has declined in recent years (see Figure 23.1); in fact, it has not reached the peaks (in constant dollars) reached in response to the oil crises of the 1970s.

With all of this institutional paraphernalia in place, what is the track record of providing support to developing countries through technology development and transfer, as envisaged in the UNFCCC?

The TEC had published 11 policy briefs as of October 2018, often coupled with background papers, which are intended to provide policy guidance to parties on a range of key technology issues. These include mitigation and adaptation, ranging from sectoral perspectives (such as industrial energy and materials efficiency and technologies for adaptation in water and agriculture) to analytical (results and success factors of TNAs) and cross-cutting (strengthening national systems of innovation to enhance climate action and enhancing access to climate technology financing) perspectives. Importantly, the focus on innovation seems to have become more prominent in the last few years, illustrated, for example, through the language in the Paris Agreement (Article 10) and activities of the TEC, such as the policy brief on technological innovation for the Paris Agreement (TEC 2017). This is consistent with the understanding of the importance of domestic innovation capabilities as being crucial to managing successful engagement with climate technologies (UNFCCC 2014).

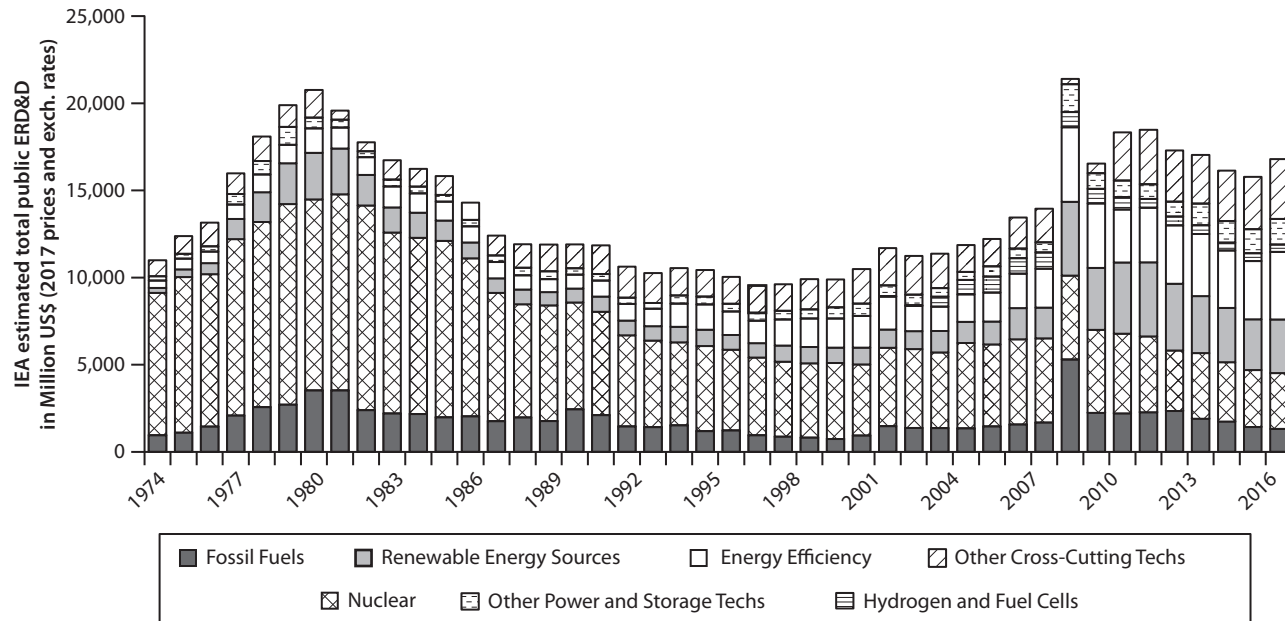


Figure 23.1 Trends in Public Energy RD&D Investments by International Energy Agency (IEA) Countries
Source: IEA (2018b).

After a slow start, CTCN has received 143 requests (as of October 2018), of which 56 have been completed, 39 are under implementation, and 25 are in the design process (with the rest being reviewed) (CTCN 2018b). The pace seems to have picked up with the putting together of the Intended Nationally Determined Contributions (INDCs) for the Paris COP (until the end of the third quarter of 2015, there were 32 requests; a year later, the total number of requests had jumped to 95) (CTCN 2018b). However, it should be noted that the CTCN is on a shoestring budget: its estimated expenditure for 2017 is just over US\$8 million (CTCN 2018c), which is miniscule, given that this is the main body under the UNFCCC tasked with providing support to all developing countries for the technological aspects of their climate actions. Of particular importance is the fact that the CTCN does not have any fund allocations through the UNFCCC—it has to depend on donor support, which leads to an unstable funding situation. Also, almost half of funding that it has secured is earmarked (CTCN 2018d). Thus, although the CTCN's activities have grown over time as countries have developed a better understanding of their needs—and therefore what to request of CTCN—and as CTCN has also gained experience in responding to requests, the financial situation of the CTCN necessarily limits the scope of the assistance it can offer.

So, while we do see some evolution and deepening of the UNFCCC approach to assisting developing countries with their technology transition, it should be noted that these efforts are rather limited in relation to the scale of the technology transition challenge. While the TEC has begun to embrace the 'national systems of innovation' approach, it is not clear that this perspective has permeated the 'on-the-ground' efforts intended to support technology development and transfer. Furthermore, the shift towards developing countries taking on ambitious targets makes their climate technology transition process that much more tricky.

Technology Transitions in the Indian Energy Sector

The Energy–Climate–Development Nexus

Since energy use is a key contributor to greenhouse gas (GHG) emissions both globally and in India—it accounted for just over 70 per cent of the country's GHG emissions in 2010, having risen

50 per cent from the preceding decade, according to the first Biennial Update Report (GoI 2015) (and a further 30 per cent between 2010 and 2015 [IEA 2018a])—it appropriately receives a disproportionate focus in GHG mitigation conversations within the climate arena. Technologies play a central role in shaping the energy sector and have, as a result, received significant attention in the climate arena (within both the policy and scholarly domains).

At the same time, provision of adequate, reliable, and affordable energy is a major policy objective for all countries, given the centrality of energy to human, social, and economic development. This becomes particularly salient for India, whose per capita energy and electricity use still is only a fraction of the global average, despite progress in these areas in the recent years. Furthermore, the lack of modern energy access for a significant fraction of the population indicates that ensuring access for all also remains a policy imperative. Both of these, of course, are linked to the issue of affordability.

The Indian policy response towards the energy–climate nexus has been multifaceted and evolving (see Chapter 19 in this volume). Many of the policy initiatives—and indeed the country’s NDCs—give prominence to renewables and energy efficiency, reflecting both our recent journey in these areas as well as national priorities. This is particularly apparent with the NDC focus on reduction of the emissions intensity of the gross domestic product (GDP) by 33–5 per cent between 2005 and 2030 and the target of 175 gigawatt (GW) of renewable by 2022 (including 100 GW of solar).²

There certainly is a case to be made that the ambitious initiatives and plans have resulted in the beginnings of a significant technological transformation of the Indian energy economy, especially in terms of enhancing energy efficiency and implementing renewables for electricity generation.

Renewable Energy

In the case of renewable energy, the Indian government has used a wide array of policies to promote renewables deployment (see also

² Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=128403>; accessed on 10 May 2018.

Chapter 24 in this volume). These include regulatory policies, such as feed-in tariffs, renewable portfolio obligations, tradable renewable energy certificates, and tendering (where reverse auctions for solar projects was a particularly innovative and successful approach), and fiscal incentives, such as investment/production tax credits, reduction in sales tax, and public financing. Although there have been hiccups with some policies, such as the accelerated depreciation on wind turbines which led to a focus on capital investments rather than energy production, overall these policies have been quite successful at accelerating the deployment of renewables in India.

To give a few examples:³ as of end of 2017, India had 18.5 GW of installed solar power generation capacity, having added 9.2 GW in 2017 (almost all solar photovoltaics [PV]). This was the third-highest solar generation capacity addition globally in 2017 (up from fourth highest in 2016). Our stated target of 100 GW of solar generation capacity by 2022 is certainly greatly accelerating deployment—the addition in 2017 was over double that of the 4.1 GW addition in 2016. However, in terms of total installed capacity, while India is sixth highest in the world, it still remains well behind the leaders—the top four countries all have an installed capacity in excess of 40 GW, with China at 130 GW (of which 53 GW was added in 2017). Having said that, the rise in India's solar generation capacity is quite remarkable given that, in 2007, our installed solar capacity was a meagre 4 megawatt (MW).

In wind power, India had a total installed capacity of almost 33 GW at the end of 2017, with an addition of 4.1 GW in 2017, the fourth highest in the world, with China again at the top with 188 GW. The country's overall wind power installed capacity has increased from 7.8 GW in 2007 to 32.9 GW in 2017, which, although not as impressive as solar, is still almost a fourfold increase over a decade.

How do we interpret these figures? Simply in terms of capacity addition, we can say that the last decade has been transformative in terms of our perspective on renewables, particularly on solar generation technologies. To some extent, the rapid rise in our installed

³ Renewables capacity data from REN21 (2018).

capacity has been enabled by policies such as reverse auctions that allowed for efficient price discovery (Energy Sector Management Assistance Program [ESMAP] 2013), which has been credited with helping reduce tariffs significantly.⁴ In fact, by 2016, the levelized cost of solar energy (weighted average) in India was among the lowest in the world (REN21 2017). However, this was also a period of a global explosion of solar and wind installed capacity, going from 100 GW in 2007 to over 900 GW in 2017 (International Renewable Energy Agency [IRENA] 2018a).

During this period, global solar installed capacity rose from 8.7 GW to 390 GW and wind power from 90 GW to 515 GW (IRENA 2018a). As a result, costs of the technologies dropped significantly: solar PV module costs dropped by 75–80 per cent between 2010 and 2015 (IRENA 2018b); and wind turbine prices dropped by 25–45 per cent (IRENA 2018d). This also allowed the generation costs to reduce substantially, to the extent that they started becoming competitive with conventional fossil fuel. The levelized cost of electricity (LCOE) of solar PV dropped from 0.347 US\$/kWh in 2010 to 0.131 US\$/kWh in 2016; and for wind, from 0.071 US\$/kWh in 2010 to 0.056 US\$/kWh in 2016 (IRENA 2018c). These unprecedented cost reductions also gave a great boost to the country's efforts to enhance renewables capacity.

While India is seen as a major success story on the electricity access front, with over 500 million people having gained access to electricity supply since 2000, when earlier only 43 per cent of the population has such access, most of these gains have come from grid extension rather than implementation of off-grid renewables power systems (IEA 2017a). Thus, the push on renewables is focused more on addressing climate mitigation and energy security rather than energy access. In other words, the accelerated deployment of renewables in the country has perhaps been motivated more by climate concerns than developmental concerns, and has been enabled to a significant extent by global cost reductions, along with deployment policies.

⁴ The tariffs are now down to Rs 2.44/kilowatt hour (kWh) (Ministry of New and Renewable Energy 2017).

Energy Efficiency

The country has also made significant progress over the last decade on the energy efficiency front. In fact, there has been forward movement on a range of areas involving a variety of technological domains. These include a standards and labelling (S&L) scheme for energy-efficient household appliances (covering 21 categories of appliances); the Perform–Achieve–Trade scheme that is part of the National Mission on Enhanced Energy Efficiency (NMEEE) and is intended to address industrial energy efficiency in firms in energy-intensive sectors; the Market Transformation for Energy Efficiency (MTEE) that is intended to promote a shift towards more energy-efficient products; and the programme on energy efficiency in buildings.

All of these programmes are intended to facilitate and accelerate the diffusion of energy-efficient technologies and practices, but each programme has taken an approach that is tailored towards the specific nature of that domain. Thus, the S&L programme was intended to both provide information to consumer to help them make more informed choices and to allow the appliance manufacturers to also develop some understanding of, and confidence in, consumer preference for energy-efficient household appliances. Therefore, it started as a voluntary programme and as the market for these energy-efficient appliances became firmer, the labels (and related standards) became mandatory. The Bureau of Energy Efficiency (BEE) estimates that as of March 2017, the S&L programme has led to an avoided generation of capacity of almost 23 GW.⁵

The MTEE programme focuses on cost reduction as way to promote the uptake of new technologies. The Bachat Lamp Yojana under this programme focused on energy-efficient compact fluorescent lamp but was replaced by the Ujala programme that focused instead on the more efficient light-emitting diodes (LEDs). Here, a combination of market aggregation and bulk procurement by Energy Efficiency Services Limited (EESL) helped reduce the price of LED bulbs from Rs 310 to Rs 38, while demand rose 50 times between 2014 and 2017 (Chunekar, Mulay, and Kelkar et al. 2017). As of 31 October 2018, over 310 million LEDs had been distributed, with

⁵ Available at <https://www.beeindia.gov.in/>; accessed on 15 May 2018.

an estimated savings of over 40 million kWh per year.⁶ The Super-Efficient Equipment Programme (SEEP) aims to provide incentives to manufacturers of equipment to develop altogether new products (such as super-efficient fans) that are also affordable. The centerpiece of the building energy efficiency programme is the Energy Conservation Building Code that specifies particular standards of energy-efficient performance for new commercial buildings above a certain size.

As in the renewables area, we see that the focus is on the implementation of new or improved technologies, starting with the early market deployment or market creation (or even development of new products, as in the case of SEEP), and then promoting their widespread diffusion. The main drivers of the renewables programme are climate mitigation and energy security; energy efficiency efforts also contribute to enhancing energy availability by allowing of a greater provision of energy services with the same generating capacity.

The Big Picture?

Yet, despite all these impressive achievements a larger strategy sometimes does not seem to be clear. For example, in the Solar Mission, Phase 1, the domestic content requirement intended to help build local industry did not really serve the purpose. Furthermore, it was challenged by the United States (US) in the World Trade Organization (WTO), leading to an adverse ruling against India (Clover 2016; FE Bureau 2018). In fact, India has really not had much success in building a solar manufacturing industry, despite these aggressive deployment targets—there is only one Indian manufacturer in the top 20 suppliers worldwide (whereas in comparison, seven of the top 10 manufacturers in 2016 were Chinese, with the country accounting for 65 per cent of the global shipments) (Natural Energy Hub 2018). China's share of global PV manufacturing has risen from 12 per cent in 2006 to 48 per cent in 2016 (IEA 2017b). The industry leaders are not very optimistic about developing significant domestic manufacturing capacity in the near term. A recent survey indicated that a majority of renewable energy chief executive officers

⁶ Available at <http://www.ujala.gov.in>; accessed on 31 October 2018.

(CEOs) felt that India would have less than 3 GW of integrated manufacturing capacity by 2022 (Bridge to India 2018b).

Sometimes, policy signals are mixed: the safeguard duty being considered by the government, driven by the Make in India, may be counterproductive in terms of achieving NDC targets in the required time frames (Bridge to India 2017a, 2017b, 2018a). While the country does have a major wind power firm (Suzlon) that is in the top 10 globally in terms of cumulative installed capacity, in 2016, it was only the sixteenth-largest supplier (*Windpower Monthly* 2017). Notably, China, again, has four firms in the 10 largest suppliers (with the remaining all being from the US or Europe).

In other words, we have not been very successful at leveraging our markets or deployment to build a successful industrial base. China, on the other hand, has taken a systematic and long-term perspective in building up its renewables industrial and innovation base (see, for example, Dai and Xue 2015), with remarkable results.

At the same time, we also have not been innovating much in climate-related technologies, whereas many Organisation for Economic Co-operation and Development (OECD) countries and even South Korea and China have significantly invested in R&D and building up innovation capabilities in these areas, as evinced by the trends in patent application data (see Figure 23.2). Specifically for renewable technologies, where India is making a major push, our performance again is rather dismal. In the area of solar power generation, where we have extraordinarily ambitious goals in terms of deployment, our record at innovation barely registers, compared to even some other major emerging economies or newly industrialized countries. Between 2009 and 2013, we had 239 patents filed in solar power; equivalent numbers for South Korea and China for the same period are 6,906 and 52,758 respectively (IRENA 2018e). This is the case even in wind power, where we have had a much longer track record: we filed 140 wind energy-related patents over this period; again, South Korea and China filed 6,906 and 17,806 patent applications (IRENA 2018e).

Thus, while India has been investing heavily on the climate technology front, particularly on renewables and energy efficiency, our focus is mostly on rapid deployment without paying adequate attention to building a large and dynamic base in these emerging

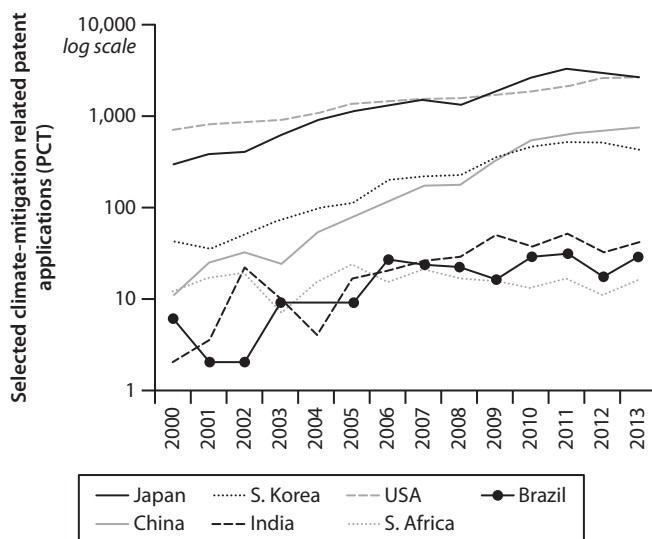


Figure 23.2 Trends in Climate-Related Patent Applications Filed under Patent Cooperation Treaty (selected by priority date and applicants' country of residence)

Note: Patent categories include climate change mitigation technologies related to buildings, energy generation, transmission or distribution, transportation, production, or processing of goods; technologies related to capture, storage, sequestration, or disposal of GHGs; and water-related adaptation technologies.

Source: OECD 2018.

industries, or building a comprehensive energy innovation system that would encompass a range of activities (see next section).

Yet another area involving low-carbon energy technology involves a nascent effort to enhance the country's clean energy R&D. As one of the founding members, India is an active participant in MI. As part of our efforts in MI, we intend to raise our clean energy RD&D expenditure from an estimated US\$72 million to US\$200 million by 2020. Of the seven challenges agreed upon by MI countries, India is taking the lead in three, namely, smart grids, off-grid access to electricity, and sustainable biofuels (MI 2018b). To promote collaborative RD&D, an international call was launched, which was open to all MI countries, to partner with India as the lead. Eighteen projects are being

supported in the first round (nine in smart grids, nine in off-grids) with a total investment of US\$10 million. The expectation is to have scalable and demonstrated off-grid solutions in two years; and the smart grid partnerships have the same timeline but without the demonstration goal. The Indian government is also investing US\$7.5 million in a smart grid research partnership with the US as part of the second phase of the Joint Clean Energy R&D Centre—this investment is being matched by Indian private partners, with a similar total amount of US\$15 million from the US side. The Indian government has also just launched a major clean energy incubator in partnership with private investors (Ministry of Science and Technology 2018). It is not very clear, though, how these R&D efforts will be linked to deployment activities and whether there is a larger strategic perspective on climate technology innovation in the country.

Looking Ahead

While concerns about climate change continue to increase and the discussions in the climate arena continue to aim to meet the UNFCCC objectives, most observers agree that meeting a 2 degree Celsius (°C) goal (leave alone 1.5°C) is increasingly unlikely (see, for example, Rogelj et al. 2016).

While technology does not offer a silver bullet to the climate problem, it certainly will be part—and an important part—of our arsenal to address climate change and its impacts. However, in order to fully harness the potential contribution of technology in this arena, developing and developed countries as well as relevant international actors (UNFCCC and others) will all have to do their part.

Industrialized countries could do much by increasing their public investments in climate technology innovation (and MI is hopefully already a good step in this direction) and send clear and consistent market signals through strong and stable climate policies. Both of these will help stimulate private investments in climate technology innovation, and eventually contribute to accelerated technology development and deployment in these countries. These, in turn, will increase the feasibility of implementing these technologies in developing countries, both through greater availability and cost reduction of climate technologies.

India and other developing countries have begun to show significant appetite for engaging with the climate issue through often-ambitious domestic goals and actions. As they do this, it will be helpful to take a systematic approach to realizing the full benefits of climate technologies. This requires aligning and synergizing climate and development goals (and resolving tensions, where needed) to get the most from their climate technology efforts. This may mean, for example, prioritizing actions that provide local air pollution and climate mitigation benefits. It may mean a focus on enhancing climate resilience of the agricultural sector that contributes to food and livelihood security, or it may mean leveraging climate technology efforts not just to decarbonize the electricity sector but also build-up an industrial base that can contribute to economic development.

Capabilities to manage technological change will play a key role in meeting climate and development goals that involve technology (R. Lema and A. Lema 2012; A. Lema and R. Lema, 2013), which require building national systems of innovation (with the understanding that different countries may have different capability needs, based on their climate technology goals and their economic and human resource context). This requires paying attention to all parts of the innovation system, including technical research capacity to develop new technologies or modify/adapt existing ones to local use conditions, the ability to facilitate the market deployment of these technologies, and eventually, diffusion at scale, which is necessary for getting the desired mitigation or adaptation outcomes.

Perhaps the most important is the strategic and coordination capability that is able to help analyse the possibilities of synergizing climate and developmental aspirations and how to translate these into specific objectives, selecting the appropriate technology pathways, developing strategies for effective implementation, and learning how to learn from their (and others') experiences. This dimension is where developing countries are often the most lacking. However, as the historical experience with newly industrialized economies—and most recently, China—has shown, a strategic and systematic approach can yield rich benefits in terms of meeting not just climate goals but also, at the same time, reducing air pollution

or building a dynamic industrial and innovation base, although it still has some way to go in catching up with the innovation leaders (Nordensvard, Zhou, and Zhang 2018).

Building up these innovation systems and capabilities for managing a climate technology transition will require efforts by both developing countries as well as the international community, as spelled out in Table 23.1. Developing country actors necessarily have to play a central role. This may involve government support for foundational activities such as R&D, or development of human resources, or broad policies to ensure availability of finance for various stages of technology commercialization, or sectoral policies to catalyse and deepen markets for low-carbon technologies. It may also require firm investments in building up their internal capabilities. Further, it may involve academic/training institutions helping advance knowledge that is relevant to specific innovation objectives, along with helping impart suitable skills to the workforce. Governments also play an important role in facilitating interactions and linkages between these various actors (such as industry and academia) and addressing innovation gaps.

International actors can also help in this process of innovation system building by providing specific technical support in various stages of the innovation cycle, whether it is technology opportunity and options analysis, technology modification/adaptation or demonstration, or setting up production facilities. They can help with development of suitable policies too, drawing on effective international experiences and helping tailor to local contexts. In fact, the TEC and the CTCN are moving in this direction, both through the provision of synthesized knowledge and advisory services as well as facilitating engagement by a wider range of actors in this process. Yet, the focus on helping strengthen strategic planning capabilities to select transition pathways that best address climate and developmental challenges in the context of specific national aspirations and abilities remains mostly absent.

All in all, managing the climate technology transition to achieve effective and efficient outcomes consistent and synergistic with developmental needs requires significant and thoughtful effort on the part of numerous actors—both public and private—at various levels, ranging from multi/plurilateral to national to sub-national.

Table 23.1 Strengthening Key Elements of National Innovation Systems

	Strategic Analysis and Coordination	Basic and Applied Research	Technology Development/ Adaptation (Including Demonstration)	Market- Focused Product and Delivery-Model Development/ Adaptation	Commercialization	Large-Scale Diffusion
Focus of NSI strengthening efforts	Development of priorities based on mitigation and adaptation options, development needs, and local capabilities and resources; identification of implementation pathways and innovation gaps; coordination of activities across innovation cycle	Scientific research capabilities	Scientific, engineering, and design capabilities; understanding of users and markets as well as product-user/market interactions		Manufacturing capability; creation of early markets; risk mitigation for early adopters/users	Refinement of delivery/business models; policies for large-scale deployment; programme/policy review and feedback
National-level activities	Identification of agency/ies to	Domestic R&D funding;	Financial and technical support for technology translation		Availability of financing for scale-up	Policies to support

(cont'd)

Table 23.1 (cont'd)

	Strategic Analysis and Coordination	Basic and Applied Research	Technology Development/ Adaptation (Including Demonstration)	Market- Focused Product and Delivery-Model Development/ Adaptation	Commercialization	Large-Scale Diffusion
	play strategic and coordination role(s)	Support for higher education and specific skills training	and product development and demonstration		of manufacturing and risk mitigation of early adopters	diffusion; demand creation
Possible international activities	Technical support for (climate and development) opportunity analysis; technology options landscaping, and local capability analysis; Implementation pathway design; Innovation gap assessment	Financial support for scientific research collaborations; human resource training; joint technology development/adaptation		Financial & technical support and training for product demonstration/ trials, user feedback, and design	Financial & technical support for manufacturers; technical support and training for financial institutions and policy-makers for market and risk-mitigation- instrument design; “best practice” knowledge sharing	Technical support and training for policy-makers; ‘best practice’ knowledge sharing

Source: Compiled by the author.

If we are to be successful at addressing climate change, we have to significantly raise the ambition to build the capabilities to manage the climate technology transition. It clearly is not easy, but there is no choice.

References

- Abdel-Latif, Ahmed. 2015. 'Intellectual Property Rights and the Transfer of Climate Change Technologies: Issues, Challenges, and Way Forward', *Climate Policy*, 15(1): 103–26.
- Bridge to India. 2017a. *Indian Solar Compass 2017 Q3: Growing but Anxious*. Gurgaon, Haryana: Bridge to India.
- . 2017b. *India Solar Compass 2017 Q4: Safeguard Duty Looms*. Gurgaon, Haryana: Bridge to India.
- . 2018a. *India RE Policy Brief: Trade Protection for Domestic Manufacturers Is Misguided*. Gurgaon, Haryana: Bridge to India.
- . 2018b. *India RE CEO Survey 2018*. Gurgaon, Haryana: Bridge to India.
- Chunekar, Aditya, Sanjana Mulay, and Mrudula Kelkar. 2017. *Understanding the Impacts of India's LED Bulb Programme, 'UJALA'*. Pune: Prayas Energy Group.
- Climate Technology Centre and Network (CTCN). 2018a. 'About'. Available at <https://www.ctc-n.org/about-ctcn>; accessed on 12 May 2018.
- . 2018b. 'Request Visualizations'. Available at <https://www.ctc-n.org/technical-assistance/request-visualizations>; accessed on 10 October 2018.
- . 2018c. 'Statement of Income and Expenditure (Preliminary) for the Period Ended December 2017'. Available at https://www.ctc-N.org/sites/www.ctcn.org/files/ab201811_11.3_preliminary_2017_financial_statement.pdf; accessed 12 May 2018.
- . 2018d. 'Financials in a Snapshot', AB/2018/11/S.7. Available at https://www.ctc-n.org/sites/www.ctc-n.org/files/ab201811_s.7_ctcn_financials_in_a_snapshot.pdf; accessed on 12 May 2018.
- Clover, Ian. 2016. 'India Loses Solar Appeal at World Trade Organization', *PV Magazine*, 19 September. Available at https://www.pv-magazine.com/2016/09/19/india-loses-solar-appeal-at-world-trade-organization_100026144/; accessed on 8 October 2018.
- Dai, Yixin and Lan Xue. 2015. 'China's Policy Initiatives for the Development of Wind Energy Technology', *Climate Policy*, 15(1): 30–57.
- Energy Sector Management Assistance Program (ESMAP). 2013. *Paving the Way for a Transformational Future: Lessons from Jawaharlal Nehru National Solar Mission Phase I*. Washington, DC: ESMAP and World Bank.

- FE Bureau. 2018. 'WTO Ruling Continues to Haunt Solar Industry', *Financial Express*, 16 March. Available at <https://www.financialexpress.com/economy/wto-ruling-continues-to-haunt-solar-industry/1100540/>.
- Government of India (GoI). 2009. *CleanNet: A Network of Climate Innovation Centers*. New Delhi: GoI.
- . 2015. *India: First Biennial Update Report to the United Nations Framework Convention on Climate Change*. New Delhi: Ministry of Environment, Forest and Climate Change, GoI.
- Haselip, James, Ulrich Elmer Hansen, Daniel Puig, Sara Trærup, and Subash Dhar. 2015. 'Governance, Enabling Frameworks and Policies for the Transfer and Diffusion of Low Carbon and Climate Adaptation Technologies in Developing Countries', *Climatic Change*, 131(3): 363–70.
- International Energy Agency (IEA). 2017a. *Energy Access Outlook 2017*. Paris: IEA/OECD.
- . 2017b. *Energy Technology Perspectives 2017: Catalysing Energy Technology Transformations*. Paris: IEA/OECD.
- . 2018a. *CO₂ Emissions from Fuel Combustion*. Paris: IEA/OECD.
- . 2018b. 'RD&D Budget', IEA Energy Technology RD&D Statistics (database). Available at <https://www.iea.org/classicstats/rddonlinedataservice/>; accessed on 11 June 2018.
- International Renewable Energy Agency (IRENA). 2018a. 'Dashboard—Capacity and Generation'. Available at <http://resourceirena.irena.org/gateway/dashboard/?topic=4&subTopic=16>; accessed on 8 October 2018.
- . 2018b. 'Dashboard—Cost'. Available at <http://resourceirena.irena.org/gateway/dashboard/?topic=3&subTopic=32>; accessed on 8 October 2018.
- . 2018c. 'Dashboard—LCOE'. Available at <http://resourceirena.irena.org/gateway/dashboard/?topic=3&subTopic=105>; accessed on 8 October 2018.
- . 2018d. 'Dashboard—Wind Costs'. Available at <http://resourceirena.irena.org/gateway/dashboard/?topic=3&subTopic=31>; accessed on 8 October 2018.
- . 2018e. 'Dashboards—Patents by Country'. Available at <http://resourceirena.irena.org/gateway/dashboard/?topic=1019&subTopic=1059>; accessed on 8 October 2018.
- Lema, Adrian and Rasmus Lema. 2013. 'Technology Transfer in the Clean Development Mechanism: Insights from Wind Power', *Global Environmental Change*, 23(1): 301–13.
- Lema, Rasmus and Adrian Lema. 2012. 'Technology Transfer? The Rise of China and India in Green Technology Sectors', *Innovation and Development*, 2(1): 23–44.

- Lewis, Joanna I. 2014. 'The Rise of Renewable Energy Protectionism: Emerging Trade Conflicts and Implications for Low Carbon Development', *Global Environmental Politics*, 14(4): 10–35.
- Lundvall, Bengt-Ake (ed.). 1992. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter.
- Metz, Bert, Ogunlade R. Davidson, Jan-Willem Martens, Sascha N.M. van Rooijen, and Laura Van Wie McGroory (eds). 2000. *Methodological and Technological Issues in Technology Transfer: A Special Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press.
- Ministry of New and Renewable Energy. 2017. 'Year End Review 2017', Press Information Bureau, 27 December. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=174832>; accessed on 24 June 2018.
- Ministry of Science and Technology. 2018. 'Dr. Harsh Vardhan Leads Indian Delegation in Mission Innovation (MI) Ministerial at Malmo, Sweden', Press Information Bureau, 23 May. Available at <http://www.dbtindia.nic.in/indian-delegation-of-mission-innovation-ministerial-2018/>; accessed on 14 October. 2018.
- Mission Innovation (MI). 2018a. 'About'. Available at <http://mission-innovation.net/about/>; accessed on 10 October 2018.
- . 2018b. 'Innovation Challenges'. Available at <http://mission-innovation.net/our-work/innovation-challenges/>; accessed on 10 October 2018.
- Natural Energy Hub. 2018. '20 Top Solar Panel Manufacturers Ruling the World (2016–2017)'. Available at <https://naturalenergyhub.com/solar-energy/20-top-solar-panel-manufacturers-ruling-world/>; accessed on 8 October 2018.
- Nelson, Richard R. (ed.). 1993. *National Innovation Systems: A Comparative Analysis*. New York and Oxford: Oxford University Press.
- Nordensvard, Johan, Yuan Zhou, and Xiao Zhang. 2018. 'Innovation Core, Innovation Semi-Periphery and Technology Transfer: The Case of Wind Energy Patents', *Energy Policy*, 120: 213–7.
- OECD. 2018. *OECD Data*. Available at <https://data.oecd.org/>; accessed on 14 June 2018.
- Ockwell, David G., Ruediger Haum, Alexandra Mallett, and Jim Watson. 2010. 'Intellectual Property Rights and Low Carbon Technology Transfer: Conflicting Discourses of Diffusion and Development', *Global Environmental Change*, 20(4): 729–38.
- Ockwell, David G. and Alexandra Mallett (eds). 2012. *Low-Carbon Technology Transfer: From Rhetoric to Reality*. London: Routledge.
- Ott, Hermann E., Wolfgang Sterk, and Rie Watanabe. 2008. 'The Bali Roadmap: New Horizons for Global Climate Policy', *Climate Policy*, 8(1): 91–5.

- REN21. 2017. *Renewables 2017 Global Status Report*. Paris: REN21 Secretariat.
- . 2018. *Renewables 2018 Global Status Report*. Paris: REN21 Secretariat.
- Rogelj, Joeri, Michel Den Elzen, Niklas Höhne, Taryn Fransen, Hanna Fekete, Harald Winkler, Roberto Schaeffer, Fu Sha, Keywan Riahi, and Malte Meinshausen. 2016. 'Paris Agreement Climate Proposals Need a Boost to Keep Warming Well below 2 C', *Nature*, 534(609): 631.
- Sagar, Ambuj D. and Bloomberg New Energy Finance (BNEF). 2010. *Climate Innovation Centres: A New Way to Foster Climate Technologies in the Developing World*: Washington, DC and Vienna: World Bank-infoDev and United Nations Industrial Development Organization.
- Sagar, Ambuj D., Cathleen Bremner, and Michael Grubb. 2009. 'Climate Innovation Centres: A Partnership Approach to Meeting Energy and Climate Challenges', *Natural Resources Forum*, 33(4): 274–84.
- Technology Executive Committee (TEC). 2017. 'Rolling Workplan of the Technology Executive Committee for 2016–2018', UNFCCC. Available at http://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_documents/74d5eb7001834aafaca82d9400a3bc8e/185fa9a5ef4645149cae4c5eed0f40a6.pdf; accessed on 10 October 2018.
- United Nations Division of Economic and Social Affairs (UNDESA). 2009. 'Climate Change: Technology Development and Transfer', Background Paper prepared for the Delhi High-Level Conference on 'Climate Change: Technology Development and Transfer', New Delhi, India, 22–3 October.
- United Nations Framework Convention on Climate Change (UNFCCC). 1992. *United Nations Framework Convention on Climate Change*. Bonn: UNFCCC.
- . 2007. 'Bali Action Plan', FCCC/CP/2007/6/Add.1, UNFCCC, Bonn.
- . 2014. 'Strengthening National Systems of Innovation to Enhance Action on Climate Change', TEC Brief, UNFCCC, Bonn.
- UNFCCC TT:CLEAR. n.d. 'Technology Executive Committee (TEC)'. Available at <http://unfccc.int/ttclear/tec>, accessed 1 June 2018.
- Windpower Monthly. 2017. 'Top Ten Turbine Makers of 2017', 2 October. Available at <https://www.windpowermonthly.com/article/1445638/top-ten-turbine-makers-2017>; accessed on 8 October 2018.

SECTION V

CLIMATE AND DEVELOPMENT

Aligning Energy, Development, and Mitigation

Ashok Sreenivas and Ashwin Gambhir

India's approach to climate-related actions has been governed by its development concerns, which include widespread poverty, the need for significant and urgent improvement in education and health, insufficient access to clean drinking water and sanitation facilities, and providing employment for a 'youth bulge', among others. In this context, energy is one of the most pivotal links between climate change and development. On the one hand, it is closely linked to a country's development and on the other, it contributes most to greenhouse gas (GHG) emissions. Energy use contributed 83 per cent of India's GHG emissions in 2013, with this share increasing over time (Figure 24.1). Thus, shifting to a less carbon-intensive energy mix is invariably the centrepiece of any discussion around climate change mitigation. With its long coastline, rainfall-dependent agriculture, and glacial-fed rivers, India is also highly vulnerable to the impacts of climate change, and workable solutions to the problem are, therefore, in India's interest. While developmental concerns and climate concerns do not always come into conflict, often there

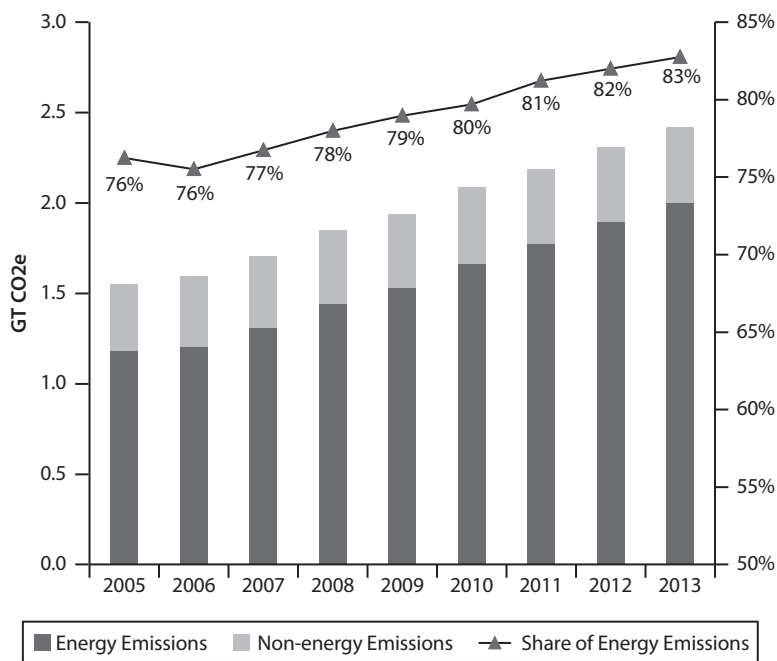


Figure 24.1 Share of Energy in India's GHG Emissions

Note: Energy emissions include those from fuel combustion and fugitive emissions, while non-energy emissions include those from 'industrial products and process use', 'waste', and 'agriculture, forestry and other land use'.

Source: 'GHG Platform India 2005–2013 National Estimates—2017 Series', July 2016. Available at <http://www.ghgplatform-india.org/>; accessed on 14 June 2019.

are difficult choices to be made between the two, calling for exploration of multidimensional approaches to understand and minimize trade-offs.

The fundamental dilemma that India faces may be summarized in a somewhat simplified manner as the relative importance to accord the short term versus the long term. In the short term, it may appear that focusing exclusively on developmental concerns is preferable for a country such as India. However, this does not take into account the extremely rapid changes that are taking place in the energy sector and the potential risks of lock-in and path dependence that may arise out of certain choices made in the short term. On the other hand,

focusing on the long term exclusively can be morally questionable and politically suicidal when faced with such pressing developmental concerns. As John Maynard Keynes famously said, ‘But this long run is a misleading guide to current affairs. In the long run we are all dead’ (Keynes 1923: 80).

In this chapter, we try to describe a few pivotal elements or trends within the energy sector which will determine how India responds to this dilemma in the coming years. We begin by presenting the key role that energy plays in India’s climate policy and India’s approach to international climate negotiations. We follow that by looking at the important trends in energy consumption and energy supply that will shape the future of energy and climate discourse in India. Next is a brief analysis of some of the crucial governance and institutional aspects around energy that will also play a very important role in how the sector unfolds.

The Role of Energy in India’s Climate Policy

Access to reliable and affordable modern energy is crucial to India as it enables many productive economic activities and can hence address many developmental challenges faced by the country. As shown in Figure 24.2, a small increase in per capita modern energy consumption correlates to a significant improvement in human development index (HDI) levels for countries such as India. However, as discussed earlier, energy also contributes to over 80 per cent of India’s GHG emissions.

It is this dual relationship of energy to climate change and development that has informed India’s position in climate negotiations. While India has recognized the need to mitigate climate change, it has also reserved its right to increase its consumption of modern energy keeping all possible options open. As a result, India has resisted taking on GHG emission restrictions and instead adopted ‘measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively’ as part of the National Action Plan on Climate Change or NAPCC (Government of India [GoI] 2008). This views climate change mitigation as one among many objectives to strive for, along with others, such as employment generation, economic growth, improved well-being of its citizens, and better local environment.

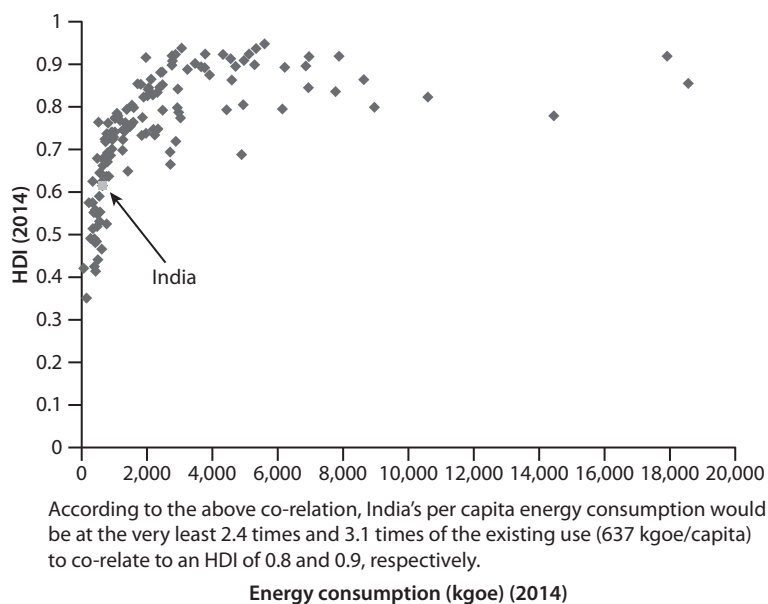


Figure 24.2 Correlation between Per Capita Energy Consumption and HDI

Note: kgoe: kilograms of oil equivalent.

Source: World Bank data indicators, Human Development Report (2016).

This approach, which focuses on decreasing the carbon intensity of India's future growth, informs India's international pledges. India's pledge at Copenhagen in 2009 stated that India would voluntarily reduce its emissions intensity of gross domestic product (GDP) by 20–5 per cent by 2020 compared to the 2005 levels (Lok Sabha Debate 2009). Under its Nationally Determined Contribution (NDC) to the 2015 Paris Agreement (GoI 2015), India's equivalent 2030 commitments are to reduce the emissions intensity of its GDP by 33–5 per cent compared to 2005 levels. As Figure 24.3 shows, this corresponds to roughly continuing the 16 per cent reduction in carbon intensity realized from 2005 to 2016. The NDC also included a pledge to achieve about 40 per cent cumulative installed electricity capacity from non-fossil fuel-based sources by 2030, as compared to a share of about 35 per cent by March 2018 (see Figure 24.4).

While international climate-driven processes such as missions and pledges have played a role in focusing attention on climate change,

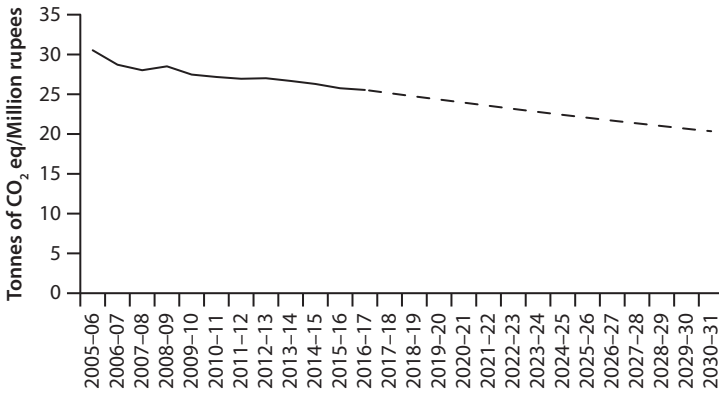


Figure 24.3 Emissions Intensity of India's GDP

Note: Projections (dotted line) based on past trends.

Source: Prayas (Energy Group) analysis based on GDP (in 2011–12 rupees) data from Reserve Bank of India; emissions data from GHG Platform India.

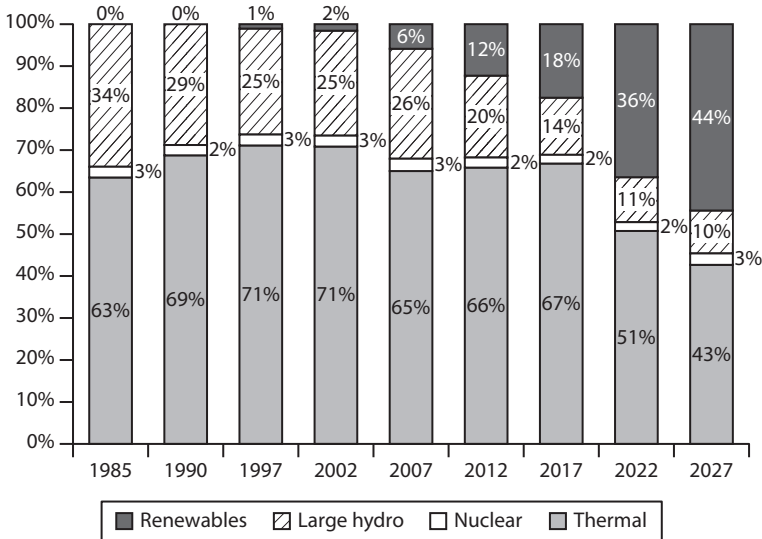


Figure 24.4 Share of Fossil Fuel-Free Capacity in India's Power Generation Capacity

Note: This does not include captive power generation. Data for 2022 and 2027 are projections based on CEA studies.

Source: Central Electricity Authority (CEA 2017a, 2018a).

specific actions have more frequently been driven by domestic concerns, such as energy security, addressing energy poverty, constraints like the poor financial health of electricity distribution utilities, and rapidly changing techno-economics. This has led to a wave of national programmes and schemes summarized in Table 24.1, many of which have an indirect but large effect on India's climate mitigation, even if they are driven by domestic motivations.

This gives a sense of the many changes underway in the Indian energy sector, with many more likely in the coming years, driven by policy and changes in economics of various technologies. The form, speed, and manner of these changes will determine how the energy sector would impact human development in India, as well as India's contribution to global GHG emissions and climate change. In the subsequent sections, we focus on a few issues that we believe would be critical as determinants of the future of the energy–climate–development troika. Consistent with the co-benefits approach of India, the trajectory of these issues would be determined by a combination of domestic factors (such as energy access and affordability, energy security and strategic considerations, employment generation, economic growth, and air and water pollution) and climate change.

Energy Consuming Sectors

India's per capita energy consumption was about 550 kilograms of oil equivalent (kgoe) in 2016, which was about one-third the global average of about 1,780 kgoe. Notably, these numbers do not include 'non-commercial' energy forms, such as biomass, dung cakes, and agricultural residue, which are still used in large quantities in India and are important energy sources for the poor. Unfortunately, data on these sources remains poor and, in this chapter, we are limited to commercial energy sources. As the government moves to address this energy poverty through various schemes as listed in Table 24.1, it is expected that energy demand would increase significantly in the coming years. The demand side of the energy equation is relatively less studied, because demand is a lot more disaggregated (millions of households, vehicles, shops, and so on) and is also influenced by less tangible aspects such as cultural and behavioural elements. However, India's future energy supply needs, and therefore GHG

Table 24.1 Important Recent Energy-Related Programmes and Schemes

Name	Description	Year	Reference
Rajiv Gandhi Grameen Vidyutikaran Yojana, Deen Dayal Upadhyaya Gram Jyoti Yojana, and Saubhagya	Targeting rural and household electrification.	2005, 2014, 2017, respectively	PIB (2005); MoP (2014); PIB (2017c), respectively
Pradhan Mantri Ujjwala Yojana (PMUY)	Promoting the use of LPG for cooking in poor households.	2016	PIB (2016c)
Ujwal DISCOM Assurance Yojana (UDAY)	Improving financial situation of electricity distribution utilities.	2015	UDAY (2015)
175 GW renewables by 2022	A large up-scaling of India's renewable energy targets consisting of 100 GW of solar and 60 GW of wind.	2015	PTI (2015)
SHAKTI and introduction of commercial coal mining	Reforms in the coal sector to auction coal linkages and a proposal to introduce commercial coal mining.	2017	MoC (2017); PIB (2017a)
Open Acreage Licensing Policy	Reforms in the oil and gas sector and a new revenue-sharing mechanism.	2016	PIB (2016a)
National Electric Mobility Mission Plan (NEMMP)	Ambitious announcements to electrify transport in India building upon NEMMP.	2015, 2017	PIB (2015); PTI (2017b); Srivastava (2017)

(cont'd)

Table 24.1 (cont'd)

Name	Description	Year	Reference
Promoting energy efficiency	A bulk procurement approach to lower costs, introduce market transformation, and promote energy efficiency as seen in the UJALA scheme for LED bulbs.	2014	UJALA (n.d.)
Biofuels	A renewed thrust on second-generation biofuels and introducing cleaner fuels.	2017	PIB (2017e); Sood (2017)
Smart Cities Mission	Proposes that these cities should source 10% of their electricity from solar sources and adopt transit-oriented development.	2015	http://smartcities.gov.in/content/

Note: GW: gigawatt; LED: light-emitting diode; LPG: liquefied petroleum gas; MoC: Ministry of Coal; MoP: Ministry of Power; PIB: Press Information Bureau; PTI: Press Trust of India.

Source: Compiled by authors.

emissions, would be directly determined by how energy demand increases.

In this section, we look at four energy demand sub-sectors, namely, residential, industrial, agricultural, and transport, that account for more than 90 per cent of India's energy consumption. Figure 24.5 gives a snapshot of energy consumption by sector in 2013. As can be seen, the industrial sector is the largest consumer of energy, followed by the transport sector, residential sector, and agriculture, respectively.

Residential Sector

India's residential energy consumption is likely to increase rapidly in the coming years given various enabling factors, such as the currently low base, aggressive government efforts to provide access to

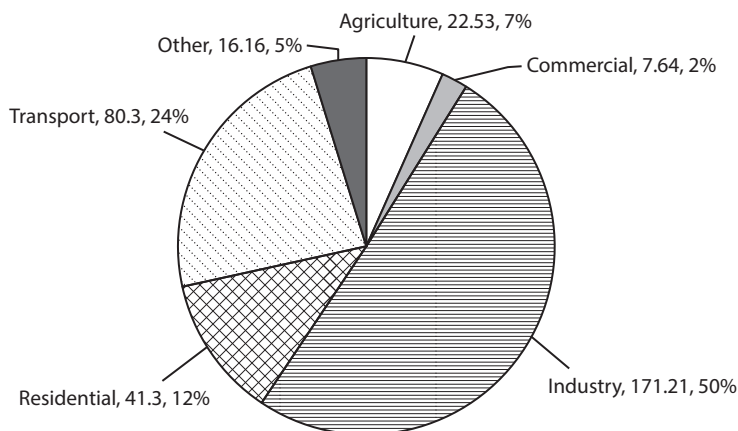


Figure 24.5 India's Final Energy Consumption in 2012–13 (in mtoe)

Notes: (i) More recent official data from sources such as Ministry of Statistics and Programme Implementation (2018) and NITI Aayog (2017b) have a large 'Others' component that distorts the real energy consumption, possibly because they classify most of the retail sales of petroleum products under the 'Other' category.

(ii) mtoe: million tonnes of oil equivalent.

Source: The Energy and Resources Institute (TERI). 2013. *TERI Energy and Environment Data Diary and Yearbook, 2012–13*. New Delhi: TERI.

modern energy forms, the aspiration to move to modern energy forms, increasing urbanization, and increasing household incomes. In particular, future residential energy consumption would be driven by how electricity use and cooking fuel use change in India.

Residential electricity use in India has more than doubled in the last 10 years, from 97 terawatt hour (TWh) in 2006 to 228 TWh in 2016, and now forms 25 per cent of total electricity consumption (NITI Aayog 2017b). This growth has been driven by increased household electrification (from 55 per cent in 2001 to over 80 per cent in 2017), faster urbanization, and rising incomes. It should be noted that, in spite of this increase, India's consumption of 90 kilowatt hour (kWh)/household/month is still only a third of the world average.¹ Residential electricity consumption has been

¹ Average consumption in India is three-fourth of China's, and a tenth of the United States (US) (World Energy Council 2016).

growing faster than other sectors, and will hence occupy a larger share of the country's total consumption in future. It is expected that residential electricity consumption will be two to three times its 2015 level by 2030. If increased appliance use is accompanied by adoption of energy-efficient solutions, it would not only reduce energy consumption and GHG emissions but also, in most cases, lower life cycle costs, though upfront costs may be higher.

Thus far, India's record in promoting energy-efficient appliances has been mixed. The Unnat Jyoti by Affordable LEDs for All (UJALA) programme was launched by the Energy Efficiency Services Limited (EESL) to promote efficiency in lighting. This initiative involved the guarantee of bulk procurement of light-emitting diode (LED) bulbs by EESL and did not involve any subsidies. It resulted in more than 300 million LED bulbs being sold by May 2018 (UJALA n.d.). While this initiative has created a large and sustainable market for LED bulbs at reduced prices, low-income households and small commercial establishments continue to buy incandescent bulbs due to their lower upfront costs, thus raising a doubt about the stated savings from the programme (Chunekar, Mulay, and Kelkar 2017).

The Bureau of Energy Efficiency (BEE) has instituted a Standards and Labelling (S&L) programme which lays down minimum energy performance criteria and mandates display of energy performance labels. The S&L programme is mandatory for some appliances such as refrigerators and air conditioners, while it is voluntary for others such as fans and washing machines. While S&L holds a lot of promise in increasing efficiency through informed consumer choice, the programme's experience has been mixed as well. While BEE's standards for 5-star frost-free refrigerators are comparable with international benchmarks, there is significant room for improvement in 1-star frost-free refrigerators and air conditioners (Abhyankar et al. 2017; Chunekar 2014).

Many studies predict a huge rise in electricity demand for cooling in India as air conditioner penetration increases (International Energy Agency [IEA] 2018; Phadke, Abhyankar, and Shah 2014). However, there is also an opportunity to mitigate this rise through other means, such as improved building architectures and designs. In India, this is being attempted through the Energy Conservation

Building Code (ECBC). The ECBC only had a code for commercial buildings until it recently introduced a code for residential buildings. Both these codes are voluntary, making them less effective. India's ability to come up with an effective building code and implement it would be a key factor in determining its future residential electricity consumption.

Access to clean cooking fuel is a second area of transformation in residential consumption: in 2011, 70 per cent of households used biomass and dung cakes as the primary cooking energy source (Census of India 2011). The Global Burden of Disease estimated that in 2016, household air pollution from solid fuels contributed to 0.78 million deaths and 22.4 million disability-adjusted life years (DALYs) lost in India, which constitute 13 per cent and 10 per cent, respectively, of deaths and DALYs from all causes and risk factors (Institute for Health Metrics and Evaluation 2017). With women doing most of the cooking, and women and girls primarily fetching solid fuels, this problem is also starkly gendered. Moreover, combustion of solid fuels results in significant GHG emissions in the form of black carbon.

To address this challenge, the government launched the Pradhan Mantri Ujjwala Yojana (PMUY) in 2016. This programme aims to provide subsidized liquefied petroleum gas (LPG) connections to 8 crore (80 million) poor households by 2020; and over 3.35 crore (33.5 million) connections have been released within two years (Press Information Bureau [PIB] 2016c, 2017f, 2018a). While this is a welcome initiative and an impressive beginning, the problem of clean cooking fuel access requires that those acquiring these connections consistently use them for their cooking needs to see significant health benefits. This would require addressing issues such as affordability, reliability, and last-mile delivery. If successful, this initiative can have a transformative impact on the country's development agenda, while also having a corresponding impact on energy consumption. However, since this is a multidimensional problem involving not only cooking fuels but also health and gender, it requires careful programme design based on consideration of the roles of various fuels and relevant stakeholders (Prayas [Energy Group] 2018b).

To summarize, India's residential energy consumption trajectories would be determined by the success or failure of a variety of

initiatives, such as its appliance efficiency programmes, building efficiency codes, and modern cooking fuel access programmes, and notably there are a number of such programmes underway.

Industry

Industry has traditionally been the largest energy consuming sector and uses close to half the final modern energy consumption in the country. Industrial energy consumption is likely to increase further in the coming years, driven not only by economic growth but also by programmes such as ‘Make in India’, which attempt to promote domestic industry so that it can contribute to 25 per cent of the country’s GDP by 2020 and also provide more employment.² The key factor determining future industrial energy consumption is the energy efficiency of future industry.

Industrial energy use has doubled from 86 million tonnes of oil equivalent (mtoe) to 173 mtoe in 10 years from 2006 to 2016 (see Figure 24.6). Coal contributes to about 60 per cent of total energy consumed in the industry sector, followed by electricity and petroleum products. The largest energy consuming industries are iron and steel, chemicals and fertilizers, and cement. According to IEA (2015), energy demand from the industrial sector is likely to grow by 2.4–3.3 times, to 417 and 572 mtoe by 2030 and 2040, respectively, with corresponding GHG emissions implications.

The climate implications of the industry sector would depend on the future trajectory of energy-intensive industries, the success of the ‘Make in India’ initiative, and the efficiency programmes proposed for the industry sector, such as the Perform–Achieve–Trade (PAT) scheme launched by BEE. Under the first cycle of PAT, a set of ‘designated consumers’—representing 478 industrial units from 8 sectors—were given reduced targets for specific energy consumption. Those who achieved more than the target were allowed to ‘sell’ the extra savings to those who underachieved. However, in the first cycle, targets were overachieved by most designated consumers (BEE 2017), suggesting that the targets were weak. The second cycle of

² Make in India web portal. Available at <http://www.makeinindia.com/about>; accessed on 14 June 2019.

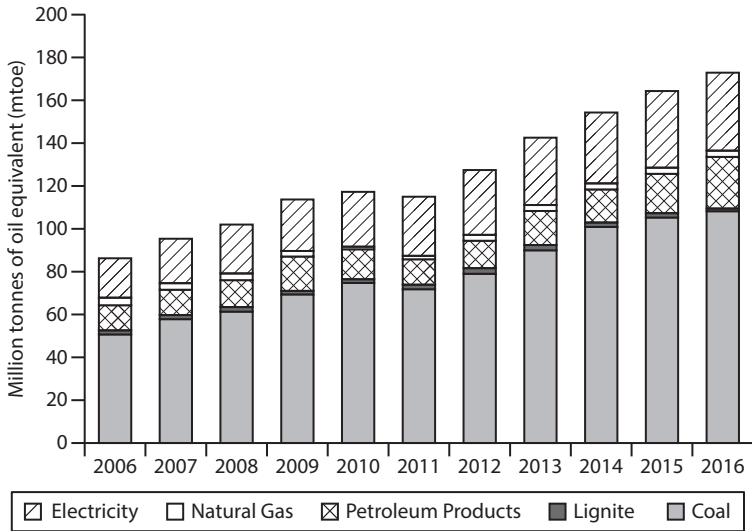


Figure 24.6 Energy Use in the Industry Sector

Source: NITI Aayog (2017b).

PAT (2016–17 to 2018–19) expanded its scope by adding three new sectors, but the targets still appear to be weak. For example, the PAT standards for some performance parameters of thermal generation and electricity distribution companies (DISCOMs) are weaker than those defined by regulators and government programmes such as Ujwal DISCOM Assurance Yojana (UDAY).

Some industrial sectors in India (such as cement) are among the most efficient in the world, while others are not. For example, India is the only major country to use coal to produce sponge iron or direct reduced iron to make steel, because of insufficient natural gas and lower upfront costs (IEA 2015). About 100,000 small-scale units using traditional methods of brick production are very energy intensive and a large source of local air pollution. In such a situation, future energy consumption of the industry sector would depend critically upon proper design and implementation of programmes such as PAT and other initiatives to promote industrial energy efficiency.

Transport

The transport sector is one of the major consumers of energy in the country. Some trends, such as the rapid growth in personal vehicle ownership and aviation, increasing urbanization, and increased movement of goods, suggest that this sector would continue to be an important energy consuming sector in the years to come. Since its predominant energy source is petroleum based, this sector is also a major cause for the country's energy import dependence, as India imports about 80 per cent of its petroleum requirement (PTI 2019).

One major change that is likely to drive the sector in future is an attempt to electrify the transport sector. A National Electric Mobility Mission Plan (NEMMP) was introduced in 2013 and up-scaled in 2015 (PIB 2015). This has been followed by more ambitious statements about selling only electric vehicles by 2030 in India (Press Trust of India [PTI] 2017a). These have been backed up by other research and regulatory studies, state-level initiatives, and bulk procurement initiatives to accelerate the adoption of electric vehicles (Forum of Regulators [FoR] 2017b; Government of Karnataka 2017; NITI Aayog and Rocky Mountain Institute [RMI] 2017; PIB 2017d). This is complemented by initiatives such as introduction of a new biofuels policy (PIB 2018b), which aims to reduce India's import dependence.

In addition to this, there are other initiatives that will impact the future of the transportation sector. The smart city mission is expected to give a fillip to public transport, particularly metro rail systems, while NITI Aayog and RMI have proposed that MaaS (Mobility as a Service) should be encouraged to disincentivize private transport, promote electric mobility, and provide cheaper, more accessible, and better-quality mobility (NITI Aayog and RMI 2017). Other initiatives in transport include: the dedicated freight corridors under construction; the proposed high-speed rail (PIB 2017b); the UDAN programme to provide air connectivity to smaller towns (PIB 2016b); and earlier-than-planned introduction of Bharat Stage VI standard of clean fuels (PIB 2017e).

The cumulative effect of these changes in the transport sector will be quite significant. If the electric mobility programme succeeds, it would have a huge impact not only on the domestic

oil and gas sector but also on India's energy imports and current account deficit, as oil imports cost India in excess of Rs 4 lakh crore (Rs 4 trillion) in 2015–16 in spite of relatively subdued oil prices (NITI Aayog 2017b). It would also significantly reduce vehicular air pollution, while its impacts on GHG emissions would depend on the electricity mix in use. The success or failure of initiatives to promote public transport and MaaS would also have a big impact on these factors.

Agriculture

Agriculture is the primary livelihood provider in rural India, contributing to food security and also providing raw material for agro-industries. Two-thirds of the total irrigated area in the country is irrigated through groundwater pumping, which accounts for most of the energy consumption in agriculture. Mechanization and fertilizer use are two other drivers of energy consumption in the agriculture sector. India's low level of mechanization and fertilizer use, coupled with the need to increase food and other agriculture production to meet the needs of its still-growing population, implies that there could be a significant increase in energy use for agriculture in future.

There are close to 2.1 crore (21 million) electricity grid-connected pumps and 0.7 crore (7 million) diesel-powered pumps in India (Central Electricity Authority [CEA] 2017b; Ministry of Power [MoP] 2011). In 2014–15, agriculture consumed about 169 billion kWh (about 18 per cent of India's electricity consumption) and about 10 billion litres of diesel for irrigation and mechanization.³ Electricity demand from agriculture is expected to double to 353 billion kWh by 2027 as per the 19th Electric Power Survey (CEA 2017c).

Reliable and affordable energy access to agriculture is an important developmental issue as it concerns livelihoods and food security. However, as illustrated by the case of Punjab, where electricity supply to farmers was free in 2016–17 when the cost of supply was Rs 6.07/kWh, the combination of farmers' low-paying ability and

³ Author's estimate for diesel use. KPMG (2014) puts the irrigation share of diesel at 4 billion litres.

high cost of supply to them makes this a difficult problem to solve (Sreekumar et al. 2013). Agricultural electricity subsidies can also place a significant demand on the exchequer and DISCOM finances. For example, agriculture received Rs 6,545 crore (Rs 65 billion) as a combination of cross-subsidy and direct subsidy in 2015–16 in Maharashtra, which is about Rs 15,400 per pump-set per year.⁴ On the other hand, agriculture continues to get low-quality, unreliable power, leading to problems such as frequent burnouts of pumps and electricity supply during non-peak hours, including late nights, making farmers distrustful of DISCOMs. This vicious cycle can only be broken through innovative solutions that can provide reliable, daytime electricity supply to farmers at reasonable tariffs, and gradual increase of mutual trust between the supplier and consumer while reducing the state's subsidy burden. Examples of such solutions include solar-powered agriculture feeders⁵ with efficient pumps (Gambhir and Dixit 2015) and better estimation of agricultural electricity consumption through feeder-level automatic metering.

Domestic Energy Supply

Coal has traditionally been the largest source of energy in India, supplying more than half of India's primary energy requirements (see Figure 24.7). Though it is used for industrial heating in sectors such as iron and steel, cement, and aluminium, its main use is for electricity generation. Various factors, such as rapidly falling prices of renewable-based electricity, increasing concerns about the social and local environmental impacts of coal, and increasing costs of coal-based electricity, are shifting the balance away from coal and towards renewable sources. This also has big implications for climate change.

⁴ Prayas (Energy Group) estimate based on electricity regulatory data.

⁵ These are grid-connected, tail-end solar photovoltaic (PV) plants of 1–5 megawatt (MW) deployed at 33/11 kilovolt (kV) substations having separate agricultural feeders. They are being piloted in Maharashtra, with plans to scale it across the state under the chief minister's solar feeder policy. In areas where feeder separation has not taken place or where the grid cannot reach, solar pumps may also be a viable option.

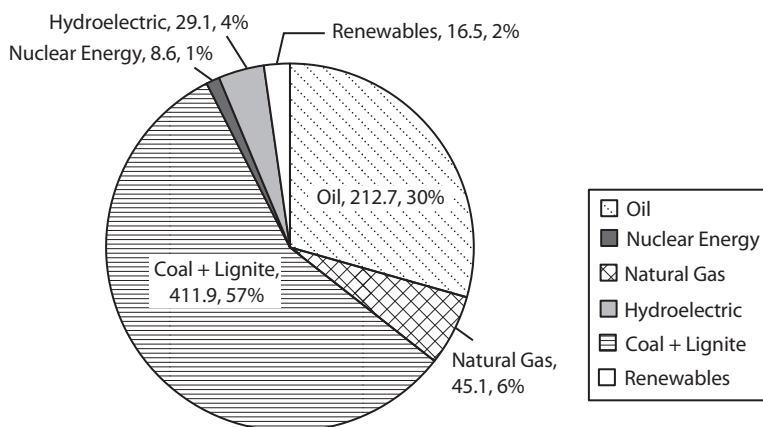


Figure 24.7 India's Total Primary Energy Supply in 2016

Source: BP (2017).

Coal and renewables are significant in another way for India: these are the two energy sources that India has in abundance. India is dependent on imports for more than 80 per cent of its oil requirements; in addition, hopes that India would be able to produce most of its natural gas requirements have been belied, with import dependence over 30 per cent in 2014–15 (NITI Aayog 2017b). Two energy sources with low import dependence are large hydro and nuclear energy. However, these sources do not play a significant role in the energy basket currently nor are they likely to in future for various reasons such as economics, safety, and ecological concerns (Dubash et al. 2018; NITI Aayog 2017a). Therefore, we analyse the drivers behind the evolution of the coal and renewables sectors in this section. We also analyse the drivers behind the evolution of electricity distribution in India, as this segment is the most challenging, and most crucial, in the electricity sector for providing affordable, reliable power to all.

Coal and Thermal Power

Coal has been India's primary source of energy and electricity. However, as discussed earlier, this sector is undergoing a transformation due to various reasons. In 2017–18, for the first time, India

added more renewable energy-based electricity generation capacity than all other sources combined (CEA 2018b: 29). However, the complete phase out of coal is likely to be gradual and take place over a few decades, since most energy investments have long lifetimes.

India's coal and thermal power sectors are riddled with various inefficiencies and have significant socio-environmental impacts (Prayas [Energy Group] 2017). Some policy documents indicate that future demand for coal is likely to be robust (Coal India Limited [CIL] 2017; NITI Aayog 2017a). These assumptions underpin some proposed reforms in the coal sector, such as auction-based allocation of coal to consumers under the SHAKTI scheme (PIB 2017a) and introduction of commercial mining (Ministry of Coal [MoC] 2017). The government has also been reluctant to revisit the ambitious coal production target of 1.5 billion tonnes by 2022 (PTI 2017c). However, these seem to be inconsistent with some ground realities and other policy measures announced by the government, as discussed further in the chapter.

India's coal-based electricity generation capacity expanded rapidly in the recent past to outstrip demand growth (Josey, Mandal, and Dixit 2017). Existing coal-based capacity is underutilized and plants have been running at utilization factors of around 60–5 per cent, rather than the norm of 80 per cent (Sharma 2017). As a result, thermal power companies form a major portion of the stressed assets of banks and the Parliamentary Standing Committee on Energy has taken serious note of the situation (Ministry of Finance 2017; Parliamentary Standing Committee on Energy 2018). Recently, private sector investment in coal-based electricity has tapered off, with most of the capacity under construction being government owned (Prayas [Energy Group] 2018a). The government proposed the introduction of stricter environmental norms for thermal power plants from December 2017,⁶ which could add Rs 0.22–0.50/kWh to the costs of coal-fired power (Centre for Science and Environment 2016; Sethi 2017). This will make coal-based electricity even less attractive in comparison to alternatives and is likely to accelerate the shift away from coal. These suggest

⁶ The norms have not come into force as of May 2018 and their implementation is likely to be delayed by a few years.

that the medium- to long-term outlook for coal demand may not be as bright as previously thought.

Thus, this sector is in a curious situation with a not-so-bright outlook but with ambitious plans. The pace of coal phase-out, the manner in which India deals with this situation, and whether it can do so without burdening ordinary citizens and electricity consumers will be a determinant of the future of thermal power in India.

The coal and thermal power sectors are also important because they provide employment, albeit hazardous, to many people. Therefore, meeting multiple objectives, such as optimizing investments, avoiding undesirable lock-ins, providing affordable and reliable power to all, providing employment, and protecting local and global environment, requires careful navigation. Since India's coal reserves are in thickly forested areas, its exploitation may also conflict with its NDC of increasing afforestation (GoI 2015). Prudent capacity addition to avoid lock-ins, enhancing competition, handling old and new regulatory challenges, addressing social and environmental impacts better, and managing costs will be some of the challenges that will have to be addressed going forward. Perhaps more than other sectors of Indian energy, the ability of the coal and thermal power sectors to develop in an equitable, fair, and optimal manner will have the greatest bearing on the future of India's energy sector and its GHG emissions.

Renewables

There is now little doubt that renewables will form the foundation of the future of India's electricity sector in particular, and energy sector in general. However, there are doubts about how soon this shift can happen and how smoothly the shift can happen—given the specific technical and regulatory challenges associated with renewables.

Renewable energy-based electricity generation has seen a strong annual growth of 20 per cent over the last 15 years, with total installed capacity as of March 2018 at 69 gigawatt (GW) or 20 per cent of total capacity (CEA 2018b).⁷ Renewables contributed 102 billion kWh (7.8 per cent) to India's electricity generation in

⁷ This does not include the 45 GW of large hydro capacity.

2017–18 (CEA 2018c). India has announced an ambitious target of 175 GW of renewable capacity by 2022, and the CEA reckons that this would contribute 20 per cent to total electricity generation (CEA 2018a). The drastically falling prices of wind and solar power and ever-increasing capacity have compelled even sceptics to acknowledge that renewable energy will play a major role in the future.

Auctions for solar and wind power in 2017 have discovered record low prices of Rs 2.44/kWh and Rs 2.43/kWh, respectively, for solar PV and wind (Das et al. 2017; Ramesh 2017). This underscores the price competitiveness of renewable energy, especially when contrasted with new coal-fired capacity being contracted in the price range of Rs 4–5/kWh (FoR 2017a). Note that these prices of wind and solar power only reflect their direct generation costs, and do not value its other benefits in terms of minimal environmental externalities, enhanced energy security, low gestation periods, and low price volatility.⁸ Therefore, generation prices are not going to be a hurdle for increased adoption of renewable energy in India.

The major challenge that now remains is of reliable and cost-effective grid integration, which requires state-of-the-art modelling to understand the additional stress and complexity on system planning and operations due to renewables. It also requires a framework to equitably distribute the additional costs of grid integration among the various stakeholders. If states can evolve a mechanism to share resources across their boundaries to further reduce the cost of system operation, it would significantly ease the integration of large quantities of renewables into the grid. As the penetration of renewable energy—which typically has ‘must-run’ status—increases, the ‘peakiness’ of the net load increases, which means that the rest of the generation fleet must have greater flexibility to respond to changes in

⁸ Being a variable source of energy, procuring renewable energy (especially wind and solar) potentially entails higher system-integration costs (especially for balancing), which need to be factored in for comparing its price with that of any baseload capacity. However, a recent study by CEA found that ‘even after including the financial implication on account of variable renewable generation, it would still be cheaper in the future to set up renewable generation capacity, as compared to coal-based capacity’ (CEA 2017d: 2).

load. Other major challenges going ahead would be optimal generation capacity planning, robust demand forecasts (including seasonal and peak/off-peak variation), capacity addition planning exercises, and appropriate system operation rules.

While the growth of renewables thus far has been nurtured through policy–regulatory instruments, such as preferential tariffs, minimum purchase obligations, and waiver from scheduling, they will increasingly have to confront the mainstream sectoral challenges. These include the poor financial health of DISCOMs, poor supply quality and weak grids, generation capacity ‘surplus’ in many states, the need to provide 24×7 universal and affordable access, and the differing priorities of the central and state governments. Another crucial variable that would determine the future trajectory of renewables is the development of technology and the regulatory regime around storage, as this can greatly help eliminate the intermittency associated with renewables.

Electricity Distribution Utilities

Electricity DISCOMs are the vital link between the electricity sector and its consumers. With the rapid changes in the electricity sector where ‘consumers’ are also ‘producers’ of electricity through on-site solar rooftop systems and the increasing likelihood of direct electricity trade between generators and (typically large) consumers, DISCOMs would have to reinvent themselves. They would have to evolve from their current role as the sole suppliers of electricity to primarily providing the physical wire infrastructure for electricity supply, fulfilling other technical functions to maintain grid stability, and perhaps be the electricity supplier to rural and small consumers.

The DISCOMs are currently beset by challenges of financial viability due to past liabilities, loss of cross-subsidy from migration of large consumers to other supply options, and increasing cost of supply, mostly due to inefficiencies in generation and distribution. This has been a long-standing problem that has evolved out of various political economy considerations as a result of which they are able to provide neither adequate access and good quality of supply nor competitive tariffs for large consumers (Dubash, Kale, and Bhavirkar 2018; Dubash and Rajan 2001; Prayas [Energy Group] 2017).

As non-DISCOM renewable energy options, such as rooftop solar pv or captive systems and procurement through the open-access/captive route, become increasingly competitive with DISCOM supply, many industrial and commercial consumers whose DISCOM tariffs are high would switch to such sources. For example, rooftop solar prices are already in the range of Rs 4–5/kWh, which is much lower than the tariffs charged to such consumers. As of 2017, for many DISCOMs, more than 50 per cent of their sales were at prices higher than rooftop solar PV costs (Sarode et al. 2017). As storage becomes more economical, this trend will only accelerate.

To deal with such an uncertain and different future, it is essential to plan and prepare the distribution sector for the inevitable transition. Indeed, the transition can be used as an opportunity to bring about meaningful reforms in the distribution sector, such as moving away from the ‘cost-plus’ approach to a benchmarking approach for distribution costs and retail tariffs, mandating and facilitating long-term sales migration through effective markets, and undertaking more realistic capacity addition planning while accounting for changing generation costs. This requires improving the efficiency and accountability of DISCOMs by addressing their governance and capacity deficits, and it is possible that the government would have to provide some form of transition financing for this purpose (Prayas [Energy Group] 2018a).

While the role of the DISCOMs may change, a robust grid and economically viable distribution sector is critical to absorb a large share of renewables. If the serious challenges facing the distribution sector are not squarely addressed, this may not be achievable, and the poor and marginalized consumers would be the most affected.

Governance and Politics

Most of the energy sector is characterized by a few traits, such as an investment-heavy nature, long gestation, long life, technical complexity, and close connections to other sectors such as the wider economy and environment. This makes effective governance of the energy sector crucial as well as challenging. The challenges are around planning, concession and contract design, and regulation. Energy governance is also very political as it involves various stakeholder

groups whose different interests have to be balanced. Electricity is a concurrent subject in the Indian Constitution, thus bringing its own challenges related to federalism.

India has traditionally grappled with serious governance challenges in the energy sector (Dubash, Kale, and Bharrvirkar 2018; Dubash and Rao 2007; Kale 2014; Pargal and Mayer 2014; Prayas [Energy Group] 2017). There is insufficient capacity, accountability, and transparency in various institutions. There have been challenges regarding planning, contract enforcement, implementation, and oversight. Institutions have structural weaknesses which limit their effectiveness. Some sectors such as coal, petroleum, and thermal power have too little competition, and some of them have weak or no independent regulatory regime. These have led to suboptimal development of these sectors leading to high costs; low access, affordability, and reliability; poor infrastructure; and adverse socio-environmental impacts.

Integrated planning of the sector has also been a challenge in India as illustrated by two examples: (i) the aggressive push for 175 GW of renewable capacity coexisting with ambitious plans for the coal sector in the presence of sluggish demand; and (ii) ambitious plans to move the transport sector towards alternative fuels such as electricity and biofuels coexisting with an equally ambitious plan to augment the country's petroleum refinery capacity (Reuters 2018).

These traditional governance challenges would get amplified with the changing nature of the energy sector, particularly the electricity sector. Introduction of intermittent renewable sources of electricity brings additional regulatory challenges, such as managing grid stability, ensuring adherence to forecasting and scheduling protocols, and fairly allocating the costs of any deviations. The techno-economic changes in the sector have already led to some regulatory disputes, such as some states trying to renegotiate contracts and the possibility of some suppliers reneging on their commitments (Bhaskar 2017; Jainani 2017). The evolution of the coal-thermal power sector, with the need for cycling of coal power plants and need for redesigning tariffs, will pose its own regulatory challenges, as will the emergence and uptake of new technologies such as electric storage or second-generation biofuels. Regulatory issues would also arise from increased penetration of electric vehicles around issues such as their

tariffs, safety and standards, and regulation of MaaS services. Energy efficiency, which should be a key component of the puzzle, can only be given the attention it deserves if the capacity, authority, and responsibility of the BEE are significantly enhanced. If the cooking fuel access problem has to be addressed effectively, the regulatory regime governing the LPG and piped natural gas (PNG) sectors has to significantly improve.

Since the energy transition would invariably involve some winners and losers, some tricky political questions would also have to be addressed. The ‘losers’ are likely to be the traditional energy sectors of coal and thermal power. Since these sectors, particularly the coal sector, are concentrated in the eastern and relatively poorer part of the country, the political impact of any job and royalty losses due to a decline in the role of coal are likely to be significant. These states are also less renewable resource rich, and therefore less likely to benefit from the ‘new’ energy sector. Similarly, a shift in the transport sector towards greater electrification and MaaS is likely to lead to fundamental shifts in the petroleum industry, automobile industry, and its ancillary services, with repercussions for the economy and employment.

As DISCOMs lose their high-paying consumers to captive or open-access renewables (with or without storage), the challenge of providing affordable and reliable electricity to the poorer households will become more acute. Similarly, politically sensitive railway passenger fares will come under pressure as the Indian Railways’ revenue from coal—the largest contributor to freight revenue—tapers off, reducing the ability of freight to subsidize passenger traffic.

The central government and state governments in India often have differing priorities. The Centre’s perspective is informed by macroeconomic stability, economic growth, and geostrategic issues, while states are driven more by local concerns and political realities, including energy access and affordability, and local jobs and economies. A transition in the energy sector would bring these differences into sharper focus. For example, the Centre may want to promote renewable energy more aggressively to reduce costs, energy imports, and pollution, as well as to meet international obligations. However, the ramifications at the state level may be different and will differ from state to state. For example, coal-rich states may lose jobs and

royalty revenue, while states with excessive renewable energy (such as Tamil Nadu) may either face grid instability or have to back down renewable energy if it cannot be despatched and sold elsewhere.

Thus, India's energy sector future and its ability to combat climate change are not only dependent on how it deals with the sectoral aspects discussed in previous sections but also on how it manages these tricky governance and political questions.

Various factors, such as a desire to improve energy access, reduction of energy import dependence, changing economics, and India's international commitments, are likely to shape India's energy sector. This is likely to result in increased electrification of the economy and an increased share of renewables, among many other changes. In order to ensure that these changes result in a fair, optimal, and sustainable development that provides its citizens with affordable and reliable access to energy while minimizing GHG emissions, India has to tread a very careful path that considers the multiple dimensions of the challenges, understands the trade-offs, and picks the best possible option (Khosla et al. 2015). This would require policy formulation to adopt a different frame of reference that includes such considerations, and adopts a much more deliberative and inclusive process.

The impending transition also provides an important opportunity. If negotiated well, India could avoid many inefficient lock-ins with significant economic and environmental costs. India can chart a new exemplary development path in which it can provide its citizens with modern energy services without necessarily compromising on other resources such as land, air, and water, while potentially opening up employment and investment opportunities in many new sectors associated with the transition. Charting such a development path would not be easy given the nature of challenges to be faced and existing institutional and systemic weaknesses, but the opportunity to do so exists in practically every sector discussed in the chapter. Whether India can rise up to this challenge will determine not only its energy future but also India's contribution to combating climate change.

References

- Abhyankar, N., N. Shah, W.Y. Park, and A. Phadke. 2017. 'Accelerating Energy Efficiency Improvements in Room Air Conditioners in India: Potential, Costs-Benefits, and Policies', Lawrence Berkeley National Laboratory, Berkeley.
- Bhaskar, U. 2017. 'Chinese Solar Module Firms Reneging on India Contracts', *Livemint*, 24 August.
- Bureau of Energy Efficiency (BEE). 2017. 'Achievements under PAT', May. Available at https://beenet.gov.in/GuideLine/Booklet_Achievements%20under%20PAT_May%202017.pdf; accessed on 12 December 2017.
- BP. 2017. 'BP Statistical Review of World Energy'. Available at <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>; accessed on 14 June 2019.
- Census of India. 2011. *Household Level Indicators*. New Delhi: Census of India.
- Central Electricity Authority (CEA). 2017a. 'Power Sector Monthly Executive Summary', March. Available at http://www.cea.nic.in/reports/monthly/executivesummary/2017/exe_summary-03.pdf; accessed on 14 June 2019.
- . 2017b. 'Monthly Executive Summary', November. Available at http://www.cea.nic.in/reports/monthly/executivesummary/2017/exe_summary-10.pdf; accessed on 14 June 2019.
- . 2017c. *19th Electric Power Survey*. New Delhi: Ministry of Power.
- . 2017d. 'Report of the Technical Committee on Study of Optimal Location of Various Types of Balancing Energy Sources/Energy Storage Devices to Facilitate Grid Integration of Renewable Energy Sources and Associated Issues', December. Available at http://cea.nic.in/reports/others/planning/resd/resd_comm_reports/report.pdf; accessed on 8 March 2018.
- . 2018a. 'Monthly Executive Summary', March. Available at http://www.cea.nic.in/reports/monthly/executivesummary/2018/exe_summary-03.pdf; accessed on 14 June 2019.
- . 2018b. 'National Electricity Plan', January. Available at http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf; accessed on 14 June 2019.
- . 2018c. 'Monthly Generation Review', March. Available at http://www.cea.nic.in/reports/monthly/generation/2018/March/actual/opm_01.pdf; accessed on 14 June 2019.
- Centre for Science and Environment. 2016. 'New Environmental Norms for the Power Sector', Centre for Science and Environment, New Delhi.

- Chunekar, A. 2014. 'Standards and Labeling Program for Refrigerators: Comparing India with Others', *Energy Policy*, 65(February): 626–30.
- Chunekar, A., S. Mulay, and M. Kelkar. 2017. *Understanding the Impacts of India's LED Bulb Programme 'UJALA'*. Pune: Prayas (Energy Group).
- Coal India Limited (CIL). 2017. 'Coal Vision 2030: Stakeholders' Consultation'. Available at https://www.coalindia.in/DesktopModules/DocumentList/documents/Coal_Vision_2030_document_for_Coal_Sector_Stakeholders_Consultation_27012018.pdf; accessed on 14 June 2019.
- Das, N., A. Gambhir, J. Sarode, and S. Dixit. 2017. 'India's Journey towards 175 GW Renewables by 2022—A July 2017 Update', September, Prayas (Energy Group), Pune.
- Dubash, N., S. Kale, and R. Bhavirkar. 2018. *Mapping Power: The Political Economy of Electricity in India's States*. New Delhi: Oxford University Press.
- Dubash, N., R. Khosla, N.D. Rao, and A. Bhardwaj. 2018. 'India's Energy and Emissions Future: An Interpretive Analysis of Model Scenarios', *Environmental Research Letters*, 13(7). Available at <http://iopscience.iop.org/article/10.1088/1748-9326/aacc74/meta>; accessed on 18 September 2018.
- Dubash, N. and S. Chella Rajan. 2001. 'Power Politics', *Economic & Political Weekly*, 36(35): 3367–90.
- Dubash, N. and N.D. Rao. 2007. *The Practice and Politics of Regulation: Regulatory Governance in Indian Electricity*. New Delhi: Macmillan India.
- Forum of Regulators (FoR). 2017a. 'Competitive Tariff vis-à-vis Cost plus Tariff-Critical Analysis', FoR. Available at www.forumofregulators.gov.in/Data/study/FOR.pdf
- . 2017b. 'Study on Impact of Electric Vehicles on the Grid', FoR.
- Gambhir, A. and S. Dixit. 2015. 'A Ray of Hope for Solar-Powered Agriculture', 8 July. Available at <http://www.thehindubusinessline.com/opinion/a-ray-of-hope-for-solarpowered-agriculture/article7399845.ece>; accessed on 12 December 2017.
- Government of India (GoI). 2008. 'National Action Plan on Climate Change'. Available at <http://www.moef.nic.in/downloads/home/Pg01-52.pdf>; accessed on 14 June 2019.
- . 2015. 'India's Intended Nationally Determined Contribution'. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=128403>; accessed on 14 June 2019.
- Government of Karnataka. 2017. 'Karnataka Electric Vehicle and Energy Storage Policy'. Available at <https://www.vtpckarnataka.gov.in/pdf/policies/Karnataka-State-Electric-Vehicle-Energy-Storage-Policy-2017-ilovepdf-compressed.pdf>; accessed on 14 June 2019.

- Human Development Report 2016. 'Human Development for Everyone'. New York: United Nations Development Programme. Available at http://hdr.undp.org/sites/default/files/2016_human_development_report.pdf and <https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE?view=chart>; accessed on 14 June 2019.
- Institute for Health Metrics and Evaluation. 2017. 'Global Burden of Disease Visualizations'. Available at <https://vizhub.healthdata.org/gbd-compare/>; accessed on 14 June 2019.
- International Energy Agency (IEA). 2015. 'India Energy Outlook'. Available at https://www.iea.org/publications/freepublications/publication/IndiaEnergyOutlook_WEO2015.pdf; accessed on 14 June 2019.
- . 2018. 'The Future of Cooling: Opportunities for Energy-efficient Air Conditioning'. Available at http://www.iea.org/publications/freepublications/publication/The_Future_of_Cooling.pdf; accessed on 14 June 2019.
- Jainani, D. 2017. 'Yogi Adityanath Government Penalises 6 Firms, Cancels Solar PPAs for Delays', *Financial Express*, 26 July.
- Josey, A., M. Mandal, and S. Dixit. 2017. *The Price of Plenty: Insights from 'Surplus' Power in Indian States*. Pune: Prayas (Energy Group).
- Kale, S. 2014. *Electrifying India: Regional Political Economies of Development*. San Francisco: Stanford University Press.
- Keynes, J.M. 1923. *A Tract on Monetary Reform*. London: MacMillan & Co.
- Khosla, R., S. Dukkupati, N.K. Dubash, A. Sreenivas, and B. Cohen. 2015. 'Towards Methodologies for Multiple Objective-Based Energy and Climate Policy', *Economic & Political Weekly*, 50(49): 49–59.
- KPMG. 2014. 'Feasibility Analysis for Solar Agricultural Water Pumps in India'. Available at <http://shaktifoundation.in/wp-content/uploads/2014/02/feasibility-analysis-for-solar-High-Res-1.pdf>; accessed on 14 June 2019.
- Lok Sabha Debate. 2009. 'Discussion Regarding Impact of Climate Change', 3 December. Available at <https://indiankanoon.org/doc/1135806/?type=print>; accessed on 14 June 2019.
- Ministry of Coal (MoC). 2017. 'Draft Discussion Paper on Auction of Commercial Coal Mining Leases'. Available at https://coal.nic.in/sites/upload_files/coal/files/curentnotices/27-03-2017-a.pdf; accessed on 14 June 2019.
- Ministry of Finance. 2017. *Economic Survey, 2016–17*. New Delhi: Government of India.
- Ministry of Power (MoP). 2011. 'Annual Report'. Available at <http://powermin.nic.in/en/content/annual-reports-year-wise-ministry>; accessed on 14 June 2019.

- _____. 2014. 'Deen Dayal Upadhyaya Gram Jyoti Yojana', Office Memorandum F. No. 44/44/2014-RE, 3 December.
- Ministry of Statistics and Programme Implementation. 2018. 'Energy Statistics', March. Available at http://www.mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2018.pdf; accessed on 14 June 2019.
- NITI Aayog. 2017a. *Draft National Energy Policy*. New Delhi: Government of India.
- _____. 2017b. 'India Energy Dashboards'. Available at <http://indiaenergy.gov.in/edm/>; accessed on 14 June 2019.
- NITI Aayog and Rocky Mountain Institute (RMI). 2017. 'India Leaps Ahead: Transformative Mobility Solutions for All'. Available at http://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf; accessed on 14 June 2019.
- Pargal, S. and K. Mayer. 2014. 'Governance of Indian State Power Utilities: An Ongoing Journey'. Available at <https://openknowledge.worldbank.org/handle/10986/20397>; accessed on 22 May 2018.
- Parliamentary Standing Committee on Energy. 2018. *37th Report: Stressed/Non-performing Assets in the Electricity Sector*. New Delhi: Lok Sabha Secretariat.
- Phadke, A., N. Abhyankar, and N. Shah. 2014. 'Avoiding 100 New Power Plants by Increasing Efficiency of Room Air Conditioners in India: Opportunities and Challenges'. Available at <https://ies.lbl.gov/sites/all/files/lbnl-6674e.pdf>; accessed on 14 June 2019.
- Prayas (Energy Group). 2017. *Many Sparks but Little Light: The Rhetoric and Practice of Electricity Sector Reforms in India*. Pune: Prayas Energy Group.
- _____. 2018a. 'Electricity Distribution Companies in India: Preparing for an Uncertain Future', Pune.
- _____. 2018b. 'Fuelling the Transition: Costs and Benefits of Modern Cooking Fuels as a Health Intervention in India', May. Available at <http://www.prayaspune.org/peg/publications/item/376>; accessed on 14 June 2019.
- Press Information Bureau (PIB). 2005. 'Electrification of Villages by REC', 14 December. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=14217>; accessed on 14 June 2019.
- _____. 2015. 'National Electric Mobility Mission Plan', 10 March. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=116719>; accessed on 14 June 2019.
- _____. 2016a. 'Major Policy Initiatives to Give a Boost to Petroleum and Hydrocarbon Sector', 10 March. Available at <http://pib.nic.in/newsite/printrelease.aspx?relid=137661>.

Press Information Bureau (PIB). 2016b. 'Ude Desh Ka Aam Naagrik: Civil Aviation Ministry's Regional Connectivity Scheme "UDAN" Launched Today', 21 October. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=151850>; accessed on 14 June 2019.

———. 2016c. 'Cabinet Approves Pradhan Mantri Ujjwala Yojana', 10 March. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=137647>; accessed on 14 June 2019.

———. 2017a. 'Cabinet Approves SHAKTI Scheme', 17 May. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=161875>; accessed on 11 October 2017.

———. 2017b. 'PM Modi and Japanese PM Abe Lay Foundation Stone for India's First High Speed Rail Project', 14 September. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=170771>; accessed on 16 November 2017.

———. 2017c. 'PM Launches Pradhan Mantri Sahaj Bijli Har Ghar Yojana "Saubhagya"', 25 September. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=171101>; accessed on 23 November 2017.

———. 2017d. 'EESL to Procure 10,000 Electric Vehicles from TATA Motors', 29 September. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=171263>; accessed on 16 November 2017.

———. 2017e. 'Pre-ponement of Introduction of BS-VI Grade Auto Fuels in NCT Delhi', 15 November. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=173517>; accessed on 16 November 2017.

———. 2017f. 'Over 2.20 Cr LPG Connections Given in 1st Year of Pradhan Mantri Ujjwala Yojana', 5 May. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=161577>; accessed on 23 November 2017.

———. 2018a. 'Cabinet Approves Enhancement of Target under Pradhan Mantri Ujjwala Yojana', 7 February. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=176351>; accessed on 14 June 2019.

———. 2018b. 'Cabinet Approves National Policy on Biofuels-2018', 16 May. Available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=179313>; accessed on 18 May 2018.

Press Trust of India (PTI). 2015. 'Budget 2015: India Targets 1,75,000 MW Green Power by 2022', *The Economic Times*, 28 February. Available at <https://economictimes.indiatimes.com/industry/energy/power/budget-2015-india-targets-175000-mw-green-power-by-2022/article-show/46409315.cms>; accessed on 14 June 2019.

———. 2017a. 'India Eyes All-Electric Car Fleet by 2030, Says Piyush Goyal', 30 April. Available at <http://www.livemint.com/Industry/JvyUPmrumUS832KL5BKzhN/India-eyes-allelectric->

- car-fleet-by-2030-says-Piyush-Goyal.html; accessed on 16 November 2017.
- . 2017b. 'Electric Vehicle Policy by December: Nitin Gadkari', 15 May. Available at <https://economictimes.indiatimes.com/news/economy/policy/electric-vehicle-policy-by-december-nitin-gadkari/article-show/58685330.cms>; accessed on 16 November 2017.
- . 2017c. 'Piyush Goyal Not Keen on Revising Coal Production Target', 4 January. Available at <https://energy.economictimes.indiatimes.com/news/coal/piyush-goyal-not-keen-on-revising-coal-production-target/56334627>; accessed on 15 November 2017.
- . 2019. 'India's Oil Import Dependence Jumps to 84 per cent', *Economic Times*, 5 May. Available at <https://economictimes.indiatimes.com/industry/energy/oil-gas/indias-oil-import-dependence-jumps-to-84-pc/articleshow/69183923.cms>; accessed on 14 June 2019.
- Ramesh, M. 2017. 'Wind Power Prices Crash to ₹2.43/Unit in Gujarat Auction', *The Hindu Business Line*, 21 December. Available at <https://www.thehindubusinessline.com/economy/wind-power-prices-crash-to-243unit-in-gujarat-auction/article9998941.ece>; accessed on 24 May 2018.
- Reuters. 2018. 'India Plans to Raise Refining Capacity by 77% by 2030, Says Govt Report', *Livemint*, 8 February. Available at <https://www.livemint.com/Industry/Dr9GQ4XhoZpNWJ4SqWv0qI/India-plans-to-raise-refining-capacity-by-77-by-2030-says.html>; accessed on 22 May 2018.
- Sarode, J., A. Gambhir, N. Das, and S. Dixit. 2017. 'Choosing Green: The Status and Challenges of Renewable Energy Based Open Access'. Available at <http://www.prayaspune.org/peg/publications/item/364>; accessed on 14 June 2019.
- Sethi, A. 2017. 'Towards a Less Polluting Power Sector', *The Hindu Business Line*, 2 August.
- Sharma, S. 2017. 'Power Utilization Continues to Drop due to Supply Glut: Report', *Livemint*, 20 April.
- Sood, J. 2017. 'Nitin Gadkari Pushes for Large-Scale Introduction of Biofuel Vehicles', *Livemint*, 2 August.
- Sreekumar, N., A. Josey, A. Chitnis, and S. Dixit. 2013. 'Ensuring Electricity for All: Ultra Mega Power Project for the Poor', Prayas (Energy Group) and Pune International Centre.
- Srivastava, V. 2017. 'Narendra Modi Government Makes Big e-Vehicle Push, to Start Test Trials by December', *Financial Express*, 14 June. Available at <http://www.financialexpress.com/economy/narendra-modi-government-makes-big-e-vehicle-push-to-start-test-trials-by-december/716928/>; accessed on 16 November 2017.

- UJALA. n.d. 'National UJALA Dashboard'. Available at <http://www.ujala.gov.in/>; accessed on 11 October 2017.
- Ujwal DISCOM Assurance Yojana (UDAY). 2015. 'Ujwal DISCOM Assurance Yojana'. Available at <https://www.uday.gov.in/home.php>; accessed on 11 October 2017.
- World Energy Council. 2016. 'Average Electricity Consumption Per Household'. Available at <https://wec-indicators.enerdata.net/household-electricity-use.html>; accessed on 12 December 2017.

Urban India and Climate Change*

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One of the defining parameters for delivering India's sustainable development agenda will be the development path chosen by urban India.

—*Economic Survey of India, 2017–18*
(Department of Economic Affairs 2018)

Cities globally are increasingly positioned as sites of climate action, placing new importance on India's urban transition. The United Nations' (UN) 2015 Sustainable Development Goals (SDGs) include an explicit goal on cities, and the 2015 Paris Climate Agreement promotes climate outcomes in national development contexts, carving out a role for cities. India is especially relevant to this discussion as it is projected to undertake the largest urban transition globally in the next few decades. In this chapter, we reflect on the implications of

* This chapter draws from a longer article—Radhika Khosla and Ankit Bhardwaj, 2019. 'Urbanization in the Time of Climate Change: Examining the Response of Indian Cities', *Wiley Interdisciplinary Reviews: Climate Change*, 10(1): 1–13—but with an emphasis on national and policy discussions.

India's urbanization for the country's energy and climate debates. We start with describing the uniqueness of India's current urban moment, synthesize the growing literature on how urban centres are responding to climate change, and discuss how emerging climate mitigation and adaptation actions can be mainstreamed into urban development.

India's Current Urban Moment

About 400-million additional people are projected to live in Indian urban settlements by 2050, a doubling in four decades from 2014 (United Nations Division of Economic and Social Affairs [UN DESA] 2014). Urban India already contributes to 63 per cent of the country's gross domestic product (GDP) and the proportion is set to increase further (High Powered Expert Committee [HPEC] 2011). To support this population and economic growth, estimates indicate that two-thirds of India's built environment will be constructed between 2010 and 2030 (Kumar et al. 2010). Transitions of such scale place extraordinary pressures on infrastructure and resources, with little doubt that urbanization will be a central determinant of India's future development.

India's urban concentrations are characterized by a set of complex features and a wide spectrum of urban form. This includes megacities such as the National Capital Region (NCR), Greater Mumbai, and Bangalore, to the many more small and medium-sized cities. Yet, across scale and density, welfare conditions remain dire. Official poverty rates hover around 15 per cent (Government of India [GoI] 2011) and one in six residents lives in officially designated slums. Also, 16 per cent of urban residents remain without water and 28 per cent are without toilets and adequate drainage. For those with access to services, quality remains low (HPEC 2011). The health of the local environment, that is, air, water, and land, is dire. The most polluted cities in the world are now in India, with limited prospects for progress (World Health Organization [WHO] 2016). As urban populations grow, the demand for basic services will rise, increasing the concerns of inclusivity and the burden on already-stretched resources and infrastructures.

Further, a distinctive feature of India's wave of substantial urbanization is that it comes at a time of global momentum on climate

change, as is exemplified by the Paris Agreement of 2015. This burden was less relevant for countries which significantly urbanized in the 2000s, when there was less imperative, though increasing pressures, for developing countries to mitigate their greenhouse gas (GHG) emissions (see Chapter 7 in this volume). As per India's Paris contribution, the country will urbanize while reducing the economy's energy intensity and fossil-fuel share of electricity (GoI 2015). By this measure, it can be argued that India is set to undertake potentially the first large-scale, climate-conscious urbanization.

Urbanization is salient to India's climate contribution for a variety of reasons. One, as the country urbanizes, rising income levels and greater access to basic services will lead to significant future urban energy demand, particularly from transport, residential, and industrial end use (ICLEI- South Asia 2009). Second, urban India is prone to a multitude of climate risks, such as coastal surges and cyclones (Sridhar 2016), uneven precipitation causing water stress (Kumar, Geneletti, and Nagendra 2016), heat waves and temperature increase (Dholakia, Mishra, and Garg 2015), and higher incidence of diseases such as malaria (Sahay 2017). These multiple risks are 'interlinked and growing' (Revi et al. 2016), and compound multiple local stressors of population growth, land use change, and industrialization (Lele et al. 2018). Climate change also compounds social vulnerabilities; thus, those without adequate shelter, drainage, and water, and with social disadvantages, in urban areas will be the most affected (Hughes 2013; Rumbach 2018; Yenneti et al. 2016). Finally, urban networks of streets, transport, and buildings, most of which are yet to be built, will endure for decades and condition consumption, waste, and social and environmental vulnerability for the long term.

Managing urban India's climate mitigation and adaptation efforts successfully will require responding to multiple and simultaneous challenges of providing services and livelihoods to many, while preserving the local environment and its increasing managing climate impacts.

Urban Approaches to Climate Change

Over the past decade, cities have emerged as potential champions in addressing climate change as they offer the advantage of operational ease through implementable projects, even when national

governments are less willing to respond to climate change (Fisher 2014). In this section, we map the evolution of India's urban climate responses and the related literature, and describe the characteristics that mark these efforts.

Evolution of Urban India's Climate Responses

The earliest Indian urban climate concerns were around vulnerability to climate stresses and disaster risks. This resulted in adaptation efforts which were easier to motivate as their benefits accrue locally, compared with the more dispersed benefits of GHG mitigation (Sharma and Tomar 2010). Early climate adaptation efforts in India were primarily dominated by two international networks: Rockefeller Foundation's Asian Cities Climate Change Resilience Network (ACCCRN); and the UN-sponsored ICLEI–Local Governments for Sustainability (Beermann et al. 2016; Fisher 2014; Hackenbroch and Woiwode 2016). The focus of these networks differed geographically, depending on local climate vulnerabilities and risks and related infrastructure deficits (Joerin et al. 2014; Sharma, Singh, and Singh 2014; Yenneti et al. 2016). In Ahmedabad, heat stress led to a call for action (Knowlton et al. 2014), while Surat (Blok 2016; Chu 2016) and Kochi (Sowmya, John, and Shrivasthava 2015) addressed the risk of sea-level rise and flooding. Water was also a recurrent focus, with efforts in Indore addressing scarcity and in Gorakhpur, waterlogging (Bahadur and Tanner 2014a).

Adaptation efforts also sought to address the complex interdependencies of urban development with climate change (Bahadur and Tanner 2014b; WS Atkins 2014). The focus on alleviating multiple risks (Kumar, Geneletti, and Nagendra 2016; Parikh, Sandal, and Jindal 2016) resulted in city departments promoting cross-cutting solutions, such as the redevelopment of green spaces, urban agriculture, and lakes (Govindarajulu 2014; Hackenbroch and Woiwode 2016; Revi et al. 2016). In Chennai, the focus on flood management explicitly focused on interdependencies between urban planning, coastal management, and real estate growth (Rajagopalan 2017). Meanwhile, in Delhi, the climate plan received criticism for not highlighting the outcomes for vulnerable groups (Hughes 2013).

Over time, the early emphasis on adaptation broadened to include GHG mitigation, consistent with the changing international climate context and India's 2009 (Copenhagen) and 2015 (Paris) pledges of economy-wide carbon intensity targets, and the increasing affordability of energy efficient and renewable technologies. The salience of urban India to national mitigation efforts also became more pronounced with accelerating energy consumption, and associated emissions, even though starting from a low base. Subsequently, urban centres came to be seen as sites for the deployment of technologically and politically feasible energy-efficient and low-carbon end-use options. National policies and schemes were started to promote various alternatives for urban areas; for example, the National Mission on Sustainable Habitat, the Smart Cities Mission, the Solar City Programme, and Green Urban Transport Mission, all have rolled out climate-friendly features, such as rooftop solar plants, public transport, bike lanes, and Energy Conservation Building Code (Hackenbroch and Woiwode 2016; Rajasekar, Chakraborty, and Bhat 2018). These are complemented by large-scale energy efficiency schemes for subsidized light-emitting diode (LED) bulbs and efficient appliances. Taken collectively, these efforts signal the larger trend of the growing climate mitigation and adaptation actions in India's urban areas.

Characteristics of Urban India's Climate Responses

In order to better understand the nature of India's urban climate responses, we describe the key characteristics that mark the range of efforts made across Indian cities: the use of local development priorities as an entry point to climate actions; the role of non-state actors in promoting climate-relevant outcomes; and the proclivity for discrete project-based activities.

The formulation of urban climate mitigation and adaptation responses has been based on linking climate change with immediate and local development needs (Aggarwal 2013; Beermann et al. 2016; Sethi and Puppim de Oliveira 2018; Sharma and Tomar 2010). This is partly because Indian city leadership has little choice but to put development first, with critical gaps in the provision of housing, transit, sanitation, safety, jobs, water, and energy infrastructure. In

addition, using development as an entry point for climate efforts is an artefact of the low awareness, and low political priority, of climate change within city governments (Fisher 2014; Sharma, Singh, and Singh 2014) as, unlike national and state governments, there is no formal mandate for cities to produce action plans on climate change (Revi 2008; Sethi and Mohapatra 2013). Of 59 city plans, an analysis found that only 10 per cent have climate-relevant strategies and 30 per cent exhibit awareness (Kumar and Geneletti 2015: 215). The focus, instead, has been on addressing more immediate and pressing developmental needs, which city governments have institutional and electoral incentives to meet (Bahadur and Tanner 2014b; Rajasekar, Chakraborty, and Bhat 2018).

By this nature, and also because of the relative centralization of Indian urban governance, city climate action often depends on state and national-level mandates and directives (Aggarwal 2013; Beermann et al. 2016; Sharma, Singh, and Singh 2014; Sharma and Tomar 2010). At the local level, there are a host of actors that implement schemes and master plans, such as the city government and the district urban development authority, and in larger urban areas, dedicated parastatal bodies are in charge of housing, transport, electricity, and water, but operate independently of the municipal government. The development decisions taken locally are shaped by the priorities of these various agencies and multiple influential actors (Bahadur and Tanner 2014a; Fisher 2014). Climate planning within this architecture is thereby often merged with national and state schemes, which ensures funds and meets local concerns. For example, in a green housing programme, the Rajkot Municipal Corporation's primary objective was to address a growing demand for low-income housing built under the central government's Housing for All programme, but the city engineers incorporated climate-adaptive elements, such as rainwater harvesting and passive cooling and ventilation, on these sites, which led to additional, climate-friendly benefits (Bhardwaj and Khosla 2017).

Such formulation of climate action has led to a growing literature on climate and local development linkages. In Delhi and Kolkata, studies proposed low-carbon residences by improving end-use efficiency, and also through rooftop solar and waste-to-energy plants (Farzaneh et al. 2014) that link both affordable and pro-poor

low-carbon projects (Colenbrander et al. 2016). In Indore and Gorakhpur, non-state actors leading climate projects had to also focus on local realities of immediate and known problems, such as garbage collection, while coping with governance in silos (Bahadur and Tanner 2014a). Local goals, however, are not always welfare or development oriented. Instead, outcomes can be influenced by powerful local lobbies: in the case of Surat, for example, well-organized entrepreneurial communities lobbied to direct adaptation activity to an industrial area at risk to sea-level rise (Blok 2016; Chu 2016).

Along with development benefits, studies are also increasingly examining health benefits of mitigation. In Surat, a waste-to-energy plant reduced carbon emissions and water pollution, accruing local health benefits (Kapshe et al. 2013; Puppim de Oliveira and Doll 2016). An India-wide study found that increase in electricity, modern cooking fuels, and clean water lowers short-term morbidity for 2.4 million people, with only modest increase in GHG emissions (Ahmad, Pachauri, and Creutzig 2017). A range of mitigation studies focus on transport and on finding incentives to increase public transit (Maitra and Sadhukhan 2013) to enhance safety, health, and air quality and reduce GHG emissions (Ahmad, Pachauri, and Creutzig 2017; Guttikunda 2008; Pathak and Shukla 2016). The Delhi Metro was evaluated for its benefit to transiting passengers and its co-benefits to air pollution and carbon mitigation (Doll and Balaban 2013; Puppim de Oliveira and Doll 2016), but also with some equity trade-offs as it disproportionately displaced the poor (Doll et al. 2013). In general, finding linkages between climate and development goals—whether politically or technically motivated—has become a key feature of urban climate responses in India.

The implementation of such urban climate efforts is a product of the collaborations between various actors at the local level. In particular, there has been a dominance of non-state actors, especially international ones, who operate in partnership with the local government. Non-state actors plug gaps of state capacity, data, and finances (Sethi and Mohapatra 2013; Sharma, Singh, and Singh 2014), and range from international donors with large climate change portfolios, global city networks such as C40 and Rockefeller Foundation's '100 Resilient Cities', consultants, and research groups, to local lobbies, private sector associations, universities, and non-governmental

organizations (NGOs) (Alankar 2015; Boyd and Ghosh 2013; Bulkeley and Castán Broto 2014; Cook and Chu 2018; Revi 2008). In these collaborations, local city actors are found to ‘bundle’ (Aggarwal 2013) and ‘steer’ (Cook and Chu 2018) partners and financing to achieve national and local climate and development actions (Padigala and Kraleti 2014)

These collaborations were either informally structured, as in Delhi (Hughes and Romero-Lankao 2014), or institutionalized, as in the case of Surat (Chu, Anguelovski, and Roberts 2017). In the latter, the city government, local chamber of commerce, education institutions, and technical consultants, backed by an international donor, set up the Surat Climate Change Trust to coordinate and direct climate change activity in the city. Set up as a trust, the organization could operate independently of national and state government procedure and even acquire funds from external organizations (Chu 2016; Karanth and Archer 2014). The ICLEI network helped Indian cities embed policy ideas, or at least seed them for the future, through techniques such as generating data inventories (Fisher 2014). In this way, climate mitigation and adaption actions in cities are the result of a negotiated relationship between state and non-state actors. Studies find that the influence in determining these actions lies mainly with city governments, donors, and influential political and industrial lobbies, often at the exclusion of actors representing vulnerable groups (Hughes 2013). Donor-driven activities have also been critiqued for their globally oriented climate motivations and outcomes-based approach, as opposed to being driven by local needs (Khosla, Sagar, and Mathur 2017).

Most urban climate responses, as a result, take the form of projects, which are implementable and aim to provide evidence of outcomes and benefits. These projects tend to be ad hoc, experimental, technical (Boyd and Ghosh 2013; Hackenbroch and Woiwode 2016), and focus on ‘win-win’ solutions (Fisher 2014). The activities are discrete and map on to existing needs and institutional frameworks of city governments, which are often largely sectoral. The limited nature of this response is partly because of governance and capacity constraints of operating in a centralized policymaking system, especially for small to medium cities. Surat’s more institutionalized approach to coordinate actions with a trust is an anomaly (Chu 2016). In the more

typical case of Mumbai, climate experiments engaged separately with the waste sector, real estate, transport networks, coastal regulations, and state pollution policies, but with little effort at coordination (Boyd and Ghosh 2013).

In the final section of this chapter, we build on this early experience of urban approaches to climate change to frame what a structured and coordinated approach to Indian urban climate policy could be.

Towards a Climate-Conscious Indian Urbanization

Responses by Indian cities to climate change are still nascent, but there is little incentive to build on this action. Most cities therefore do not mention, let alone adequately address, climate change in their development plans (Kumar and Geneletti 2015). If the approaches so far are indicative, the future trajectory of urban responses to climate change in India will be shaped by how local development and climate goals will be linked and prioritized. While a range of Indian cities are beginning to embark on identifying such linkages, a strategic understanding of interacting climate and development priorities, across governance levels, is yet to be developed. A solely project-based approach is insufficient as cities are not culminations of sites and projects but entail complex systems, interacting infrastructures, and socio-technical systems. Given the magnitude of change that Indian cities will face in the coming years, and their impending challenges of inclusivity and vulnerability, this section outlines the considerations by which climate actions can be mainstreamed in urban areas.

Structural Changes and Lock-in

Most of urban India is yet to be built. This particular aspect of cities offers, perhaps counter-intuitively, a potential advantage. Decisions about urban form are still open, and once made will lock-in energy and carbon consumption patterns for the long term. How cities are built over the next decade will condition how most Indians live until the end of the century: in the choice of building types; in how they expend energy; in the amount of distance travelled, and the ways in which distances are covered. These choices will have material consequences for air, water, congestion, energy, and climate change,

amongst others. So far though, curtailment of urban sprawl and planning for strategic densification is not yet on the policy radar.

Similarly, for adaptation, infrastructure that accounts for climate risks will need to address the current deficit for vulnerable groups, and also alleviate local climate risks such as flooding, heat islands, water security, and air pollution. While more climate-specific infrastructures such as levees, rainwater harvesting systems, and passive cooling buildings will also be required, it is important to stress that Indian cities are especially vulnerable to climate risks as they have not yet extended basic infrastructures such as storm drainage, municipal water supply networks, wastewater systems, public shade, and shelter to all. Ensuring these basic infrastructures are in place during the impending transition is essential in adapting urban India to climate change.

As urban spaces provide a physical setting for shaping preferences and practices, lock-in effects are not easily reversed and the cost of switching infrastructures and behaviours can be prohibitively high. The current ability of India's cities to determine their urban form is a distinctive window of opportunity to choose alternative development pathways that do not compromise on quality of life, and yet also internalize long-term climate responses. This opportunity, however, will only be as useful as the decisions that cities make within the next 5–10 years.

Multiple Objective-Based Planning

City officials have multiple objectives, including urban development goals—such as water, waste, energy, mobility, and land use—and climate change, which are interrelated and vary in salience for different political actors and constituencies (Bhardwaj and Khosla 2017, 2018; Pathak et al. 2015; Sethi and Puppim de Oliveira 2018). Climate change impacts and solutions are embedded in these interconnected goals, and an increasing set of examples, as previously described, demonstrate how national policy and city initiatives are incorporating climate action into urban planning. These initiatives are primarily driven by the synergy between city development and climate goals, which serves as an effective and politically viable entry point for city climate action. However, the decisions are more

complicated when cities need to make a trade-off between climate and development.

A potential methodological tool to evaluate the linkages between different urban objectives systematically is to use a multiple objectives framework. The framework draws from the literature on co-benefits and provides a structure to assess multiple and simultaneous urban priorities, which can be economic, environmental, social, or governance based, and subsequently identify the synergies and trade-offs across them (Khosla et al. 2015). Cities can use the framework to identify schemes, technologies, plans, and projects which can potentially achieve both development and climate concerns. Alternatively, they can also make explicit the trade-offs that policy decisions inevitably lead to and provide a more transparent and rigorous basis for doing so. Recent tools, such as the multidimensional urban liveability index proposed by the Ministry of Urban Development (MoUD) and the cross-sectoral focus of the Smart Cities Mission's visioning process, indicate a policy shift aimed at understanding the multi-objective needs of India's urbanity (MoUD 2017). However, a more structured multiple objectives approach can help cities push beyond their conventional piecemeal actions and create strategic and systemic links between climate change and urban goals.

Institutionalizing Urban Climate Responses

Redirecting urbanization from existing energy and carbon-intensive pathways will require an institutional structure that is able to leverage interactions across sectors, as opposed to the current compartmentalized project-based approach. However, Indian cities have little incentive and are under-equipped in terms of technical or financial capacity to reap such systemic benefits, particularly with respect to climate change. Most urban bodies have limited their focus on discrete projects which are ad hoc and rarely coordinated (Hughes and Romero-Lankao 2014), instead of a strategic integration of climate adaptation and mitigation agendas (Boyd and Ghosh 2013; Chu, Angelovski, and Roberts 2017). Coordination between these projects is made further difficult by the multi-level nature of urban governance and sector-specific silos within which decisions are made, often leading to conflicting actions (Bahadur and Tanner 2014a;

Bhardwaj and Khosla 2018; Kumar and Geneletti 2015; Revi et al. 2016; Sharma and Tomar 2010).

The sharing of best practices and recent city-level schemes, such as in Surat, are beginning to encourage integration. National programmes such as the Transit Oriented Development Policy, Green Urban Mobility Scheme, and aforementioned Smart Cities Mission, and Liveability Index for Cities, attempt to promote coordination and cooperation across departments, particularly to align urban action with national objectives. A more successful institutional architecture would involve the creation of spaces for such cross-sectoral strategizing and coordination, and working across governance levels to enhance the role of urban governments (Bhardwaj and Khosla 2017; Doll et al. 2013; Revi et al. 2016; Sethi and Mohapatra 2013).

In conclusion, this chapter reflects on India's urban responses to climate change in light of the larger urbanization trend taking place in the country. We synthesize the growing research on this issue and describe the narratives that mark these actions. While the synthesized literature often suggests the need for more local responses to climate change, regional considerations also enter play. For example, Delhi's climate change plan stands out with its proposed coordination with upstream states, Haryana and Himachal Pradesh, to ensure water sharing and security (Aggarwal 2013). A city's air pollution problem is also as much a challenge of addressing local concerns, such as transit and waste management, as the agricultural practice in upwind states. A strategic and coordinated approach that acknowledges such unbounded urban challenges, and the window of opportunity to lock-in lower consumption and sustainable infrastructures, could be an important shaper of India's low-carbon development path.

References

- Aggarwal, Rimjhim M. 2013. 'Strategic Bundling of Development Policies with Adaptation: An Examination of Delhi's Climate Change Action Plan', *International Journal of Urban and Regional Research*, 37(6): 1902–15.

- Ahmad, Sohail, Shonali Pachauri, and Felix Creutzig. 2017. 'Synergies and Trade-offs between Energy-Efficient Urbanization and Health', *Environmental Research Letters*, 12(11): 114017. Available at <https://doi.org/10.1088/1748-9326/aa9281>.
- Alankar. 2015. 'India's Megacities and Climate Change: Explorations from Delhi and Mumbai', STEPS Working Paper No. 79, STEPS Centre, Sussex, United Kingdom.
- Bahadur, Aditya and Thomas Tanner. 2014a. 'Policy Climates and Climate Policies: Analysing the Politics of Building Urban Climate Change Resilience', *Urban Climate*, 7: 20–32.
- . 2014b. 'Transformational Resilience Thinking: Putting People, Power and Politics at the Heart of Urban Climate Resilience', *Environment and Urbanization*, 26(1): 200–14. Available at <https://doi.org/10.1177/0956247814522154>.
- Beermann, Jan, Appukuttan Damodaran, Kirsten Jörgensen, and Miranda A. Schreurs. 2016. 'Climate Action in Indian Cities: An Emerging New Research Area', *Journal of Integrative Environmental Sciences*, 13(1): 55–66. Available at <https://doi.org/10.1080/1943815X.2015.1130723>.
- Bhardwaj, Ankit and Radhika Khosla. 2017. 'Mainstreaming Climate Action in Indian Cities: Case Study of Rajkot', Policy Brief, Centre for Policy Research, New Delhi.
- . 2018. 'Integrating Urban Development and Climate Objectives: Insights from Coimbatore', Policy Brief, Centre for Policy Research, New Delhi.
- Blok, Anders. 2016. 'Assembling Urban Riskscales: Climate Adaptation, Scales of Change and the Politics of Expertise in Surat, India', *City*, 20(4): 602–18.
- Boyd, Emily and Aditya Ghosh. 2013. 'Innovations for Enabling Urban Climate Governance: Evidence from Mumbai', *Environment and Planning C: Government and Policy*, 31(5): 926–45. Available at <https://doi.org/10.1068/c12172>.
- Bulkeley, Harriet and Vanesa Castán Broto. 2014. 'Urban Experiments and Climate Change: Securing Zero Carbon Development in Bangalore', *Contemporary Social Science*, 9(4): 393–414.
- Chu, Eric. 2016. 'The Political Economy of Urban Climate Adaptation and Development Planning in Surat, India', *Environment and Planning C: Government and Policy*, 34(2): 281–98. Available at <https://doi.org/10.1177/0263774X15614174>.
- Chu, Eric, Isabelle Anguelovski, and Debra Roberts. 2017. 'Climate Adaptation as Strategic Urbanism: Assessing Opportunities and Uncertainties for Equity and Inclusive Development in Cities',

- Cities*, 60(Part A): 378–87. Available at <https://doi.org/10.1016/j.cities.2016.10.016>.
- Colenbrander, Sarah, Andy Gouldson, Joyashree Roy, Niall Kerr, Sayantan Sarkar, Stephen Hall, Andrew Sudmant, et al. 2016. 'Can Low-Carbon Urban Development be Pro-Poor? The Case of Kolkata, India', *Environment and Urbanization*, 29(1): 139–58.
- Cook, Mitchell J. and Eric K. Chu. 2018. 'Between Policies, Programs, and Projects: How Local Actors Steer Domestic Urban Climate Adaptation Finance in India', in S. Hughes, E.K. Chu, and S.G. Mason, *Climate Change in Cities*, pp. 255–77. Cham, Switzerland: Springer.
- Department of Economic Affairs. 2018. *Indian Economic Survey 2017–18*. New Delhi: Economic Division, Department of Economic Affairs, Ministry of Finance, Government of India.
- Dholakia, Hem H., Vimal Mishra, and Amit Garg. 2015. 'Predicted Increases in Heat Related Mortality Under Climate Change in Urban India'. IIMA Working Paper No. WP2015-05-02, Research and Publication Department, Indian Institute of Management, Ahmedabad, India.
- Doll, Christopher N.H. and Osman Balaban. 2013. 'A Methodology for Evaluating Environmental Co-Benefits in the Transport Sector: Application to the Delhi Metro', *Journal of Cleaner Production*, 58: 61–73.
- Doll, Christopher N.H., Magali Dreyfus, Sohail Ahmad, and Osman Balaban. 2013. 'Institutional Framework for Urban Development with Co-Benefits: The Indian Experience', *Journal of Cleaner Production*, 58(November): 121–9. Available at <https://doi.org/10.1016/j.jclepro.2013.07.029>.
- Farzaneh, Hooman, Aki Suwa, Christopher N.H. Dolla, and Jose Antonio, Puppim de Oliveira. 2014. 'Developing a Tool to Analyze Climate Co-Benefits of the Urban Energy System', *Procedia Environmental Sciences*, 20: 97–105. Available at <https://doi.org/10.1016/j.proenv.2014.03.014>.
- Fisher, Susannah. 2014. 'Exploring Nascent Climate Policies in Indian Cities: A Role for Policy Mobilities?', *International Journal of Urban Sustainable Development*, 6(2): 154–73. Available at <https://doi.org/10.1080/19463138.2014.892006>.
- Government of India (GoI). 2011. '*Populations Census 2011*.' New Delhi: Census of India.
- . 2015. 'India's Intended Nationally Determined Contribution: Working towards Climate Justice'. Available at <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf>; accessed on 13 June 2019.
- Govindarajulu, Dhanapal. 2014. 'Urban Green Space Planning for Climate Adaptation in Indian Cities', *Urban Climate*, 10: 35–41.

- Guttikunda, Sarath. 2008. *Co-Benefits Analysis of Air Pollution and GHG Emissions for Hyderabad, India*. Washington, DC: Integrated Environmental Strategies Program.
- Hackenbroch, Kirsten and Christoph Woiwode. 2016. 'Narratives of Sustainable Indian Urbanism: The Logics of Global and Local Knowledge Mobilities in Chennai', *South Asia Multidisciplinary Academic Journal*, 14: 1–24.
- High Powered Expert Committee (HPEC). 2011. *Report on Indian Urban Infrastructure and Services*. New Delhi: The High Powered Expert Committee (HPEC) for Estimating the Investment Requirements for Urban Infrastructure Services.
- Hughes, Sara. 2013. 'Justice in Urban Climate Change Adaptation: Criteria and Application to Delhi', *Ecology and Society*, 18(4). Available at <https://doi.org/10.5751/ES-05929-180448>.
- Hughes, Sara and Patricia Romero-Lankao. 2014. 'Science and Institution Building in Urban Climate-Change Policymaking', *Environmental Politics*, 23(6): 1023–42. Available at <https://doi.org/10.1080/09644016.2014.921459>.
- ICLEI-South Asia. 2009. 'Energy and Carbon Emissions Profiles of 54 South Asian Cities', British High Commission, New Delhi, India.
- Joerin, Jonas, Rajib Shaw, Yukiko Takeuchi, and Ramasamy Krishnamurthy. 2014. 'The Adoption of a Climate Disaster Resilience Index in Chennai, India', *Disasters*, 38(3): 540–61.
- Kapshe, Manmohan, Paulose N. Kuriakose, Garima Srivastava, and Akhilesh Surjan. 2013. 'Analysing the Co-Benefits: Case of Municipal Sewage Management at Surat, India', *Journal of Cleaner Production*, Special Volume: Climate Co-Benefits in Urban Asia, 58(Supplement C): 51–60. Available at <https://doi.org/10.1016/j.jclepro.2013.07.035>.
- Karant, Anup and Diane Archer. 2014. 'Institutionalising Mechanisms for Building Urban Climate Resilience: Experiences from India', *Development in Practice*, 24(4): 514–26. Available at <https://doi.org/10.1080/09614524.2014.911246>.
- Khosla, Radhika, Srihari Dukkupati, Navroz K. Dubash, Ashok Sreenivas, and Brett Cohen. 2015. 'Towards Methodologies for Multiple Objective-based Energy and Climate Policy', *Economic & Political Weekly*, 50(49): 49–59.
- Khosla, Radhika, Ambuj Sagar, and Ajay Mathur. 2017. 'Deploying Low-Carbon Technologies in Developing Countries: A View from India's Buildings Sector', *Environmental Policy and Governance*, 27(2): 149–62.
- Knowlton, Kim, Suhas P. Kulkarni, Gulrez Shah Azhar, Dileep Mavalankar, Anjali Jaiswal, Meredith Connolly, Amruta Nori-Sarma, et al. 2014. 'Development and Implementation of South Asia's First Heat-Health

- Action Plan in Ahmedabad (Gujarat, India)', *International Journal of Environmental Research and Public Health*, 11(4): 3473–92. Available at <https://doi.org/10.3390/ijerph110403473>.
- Kumar, Parveen and Davide Geneletti. 2015. 'How Are Climate Change Concerns Addressed by Spatial Plans? An Evaluation Framework, and an Application to Indian Cities', *Land Use Policy*, 42: 210–26.
- Kumar, Parveen, Davide Geneletti, and Harini Nagendra. 2016. 'Spatial Assessment of Climate Change Vulnerability at City Scale: A Study in Bangalore, India', *Land Use Policy*, 58: 514–32.
- Kumar, Satish, Ravi Kapoor, Rajan Rewal, Sanjay Seth, and Archana Walia. 2010. 'Developing an Energy Conservation Building Code Implementation Strategy in India', USAID India, New Delhi.
- Lele, Sharachchandra, Veena Srinivasan, Bejoy K. Thomas, and Priyanka Jamwal. 2018. 'Adapting to Climate Change in Rapidly Urbanizing River Basins: Insights from a Multiple-Concerns, Multiple-Stressors, and Multi-Level Approach', *Water International*, 43(2): 1–24.
- Maitra, Bhargab and Shubhajit Sadhukhan. 2013. 'Urban Public Transportation System in the Context of Climate Change Mitigation: Emerging Issues and Research Needs in India', in A. Khare and T. Beckman (eds), *Mitigating Climate Change*, pp. 75–91. Heidelberg: Springer.
- Ministry of Urban Development (MoUD). 2017. *Liveability Standards in Cities*. New Delhi: MoUD.
- Padigala, Bhaskar and Sunil Kraleti. 2014. 'Financing Low Carbon Urban Development through Clean Development Mechanism', *International Journal of Environmental Sciences*, 5(1): 98–116.
- Parikh, Jyoti, Geeta Sandal, and Priyank Jindal. 2016. 'Climate Resilient Cities: Vulnerability Profiling of Twenty Indian Cities', in S. Mahendra Dev and P.G. Babu (eds), *Development in India*, pp. 351–65. New Delhi: Springer.
- Pathak, M. and P.R. Shukla. 2016. 'Co-Benefits of Low Carbon Passenger Transport Actions in Indian Cities: Case Study of Ahmedabad', *Transportation Research Part D: Transport and Environment*, 44: 303–16.
- Pathak, M., P.R. Shukla, A. Garg, and H. Dholakia. 2015. 'Integrating Climate Change in City Planning: Framework and Case Studies', in S. Mahendra Dev and P.G. Babu, *Cities and Sustainability*, pp. 151–77. New Delhi: Springer.
- Puppim de Oliveira, Jose A. and Christopher N.H. Doll. 2016. 'Governance and Networks for Health Co-Benefits of Climate Change Mitigation: Lessons from Two Indian Cities', *Environment International*, 97: 146–54.
- Rajagopalan, Lakshmi. 2017. 'Integrating Climate Adaptation into Urban Development and Infrastructure Planning in Indian Cities: Urban Flood

- Vulnerability and Responsibility in Chennai, Tamil Nadu, India', in The Wilson Center (ed.), *Urban Perspectives*, pp. 50–64. Washington, DC: The Wilson Center.
- Rajasekar, Umamaheshwaran, Soumita Chakraborty, and Gopalkrishna Bhat. 2018. 'Climate Resilient Smart Cities: Opportunities for Innovative Solutions in India', in *Climate Change in Cities*, pp. 203–27. Cham: Springer. Available at https://doi.org/10.1007/978-3-319-65003-6_11.
- Revi, Aromar. 2008. 'Climate Change Risk: An Adaptation and Mitigation Agenda for Indian Cities', *Environment and Urbanization*, 20(1): 207–29.
- Revi, Aromar, Sumetee Pahwa Gajjar, Ritwika Basu, Garima Jain, and Amir B. Bazaz. 2016. 'Bangalore, India', in S. Bartlett and D. Satterthwaite (eds), *Cities on a Finite Planet: Towards Transformative Responses to Climate Change*, pp. 41–62. Abingdon, Oxon, England: New York, NY: Routledge.
- Rumbach, Andrew. 2018. 'At the Roots of Urban Disasters: Planning and Uneven Geographies of Risk in Kolkata, India', *Journal of Urban Affairs*, 39(6): 1–17.
- Sahay, Samraj. 2017. 'Urban Adaptation to Climate Sensitive Health Effect: Evaluation of Coping Strategies for Dengue in Delhi, India', *Sustainable Cities and Society*, 37: 178–88.
- Sethi, Mahendra and Subhakanta Mohapatra. 2013. 'Governance Framework to Mitigate Climate Change: Challenges in Urbanising India', in H. Ha and T.N. Dhakal (eds), *Governance Approaches to Mitigation of and Adaptation to Climate Change in Asia*, pp. 200–30. Houndmills, Basingstoke, Hampshire, UK & New York, NY: Palgrave Macmillan.
- Sethi, Mahendra and Jose A. Puppim de Oliveira (eds). 2018. *Mainstreaming Climate Co-Benefits in Indian Cities: Post-Habitat III Innovations and Reforms*, 1st edition. New York, NY: Springer.
- Sharma, Divya, Raina Singh, and Rozita Singh. 2014. 'Building Urban Climate Resilience: Learning from the ACCCRN Experience in India', *International Journal of Urban Sustainable Development*, 6(2): 133–53. Available at <https://doi.org/10.1080/19463138.2014.937720>.
- Sharma, Divya and Sanjay Tomar. 2010. 'Mainstreaming Climate Change Adaptation in Indian Cities', *Environment and Urbanization*, 22(2): 451–65. Available at <https://doi.org/10.1177/0956247810377390>.
- Sowmya, K., C.M. John, and N.K. Shrivasthava. 2015. 'Urban Flood Vulnerability Zoning of Cochin City, Southwest Coast of India, Using Remote Sensing and GIS', *Natural Hazards*, 75(2): 1271–86.
- Sridhar, Kala Seetharam. 2016. 'Economic Impacts of Climate Change in India's Cities', in S. Nautiyal, R. Schaldach, K.V. Raju, H. Kaechele,

- B. Pritchard, and K. S. Rao (eds), *Climate Change Challenge (3C) and Social–Economic–Ecological Interface-Building*, pp. 279–95. Cham, Switzerland: Springer.
- United Nations Division of Economic and Social Affairs (UN DESA). 2014. ‘*World Urbanization Prospects: The 2014 Revision, Highlights*.’ New York: Population Division, UN DESA.
- World Health Organization (WHO). 2016. ‘WHO Global Urban Ambient Air Pollution Database (update 2016)’, WHO, Geneva, Switzerland.
- WS Atkins. 2014. ‘*Future Proofing Indian Cities: Key Findings from Applying a Future Proofing Approach in Bangalore and Madurai*.’ Surrey, UK: WS Atkins, University College London, Development Planning Unit, The Indian Institute for Human Settlements, The Development of Humane Action Foundation.
- Yenneti, Komali, Sabyasachi Tripathi, Yehua Dennis Wei, Wen Chen, and Gaurav Joshi. 2016. ‘The Truly Disadvantaged? Assessing Social Vulnerability to Climate Change in Urban India’, *Habitat International*, 56: 124–35.

Climate Change and India's Forests

Sharachchandra Lele and Jagdish Krishnaswamy

Forest ecosystems are linked to the climate change problem in several ways. Standing forests are repositories of carbon and growing forests can be net carbon sinks. So, conserving existing forests and creating new or denser forests helps in the mitigation of global climate change. Forests also mediate other climatic processes that are being influenced by global climate change, such as rainfall. However, climate regulation—whether global or regional—is not the only benefit that forests provide to society, especially in a country like India. An exclusive focus on the climate benefits can therefore affect other forest-related benefits. Simultaneously, forests are being affected by climate change, thereby influencing their ability to provide these other benefits. To understand the relationship between forests and climate change in India, we begin by first elucidating the socio-ecological nature of forests in general, and the ongoing contestation in India over the control and management of these forests in particular. We then look at the possible role of India's forests in mitigating climate change through carbon sequestration, and also their role in other climate processes. Finally, we discuss how looming climate change may, in turn, shape India's forests and forest-related benefits.

Social Ecology of India's Forests

India's forests cover about 70 million hectares or about 21 per cent of the country's landscape (FSI 2015: 38). This bald statement hides the diversity of forest types, histories, and social settings in which forests exist. Ecologically, the forest types in India range from the temperate needle-leaf and broadleaf forests of the Himalayas to the tropical evergreen forests of the Western Ghats, with a large portion in central India covered with dry deciduous teak- or sal-dominated tracts and other regions with drier scrub-thorn vegetation. Given the confusion between legal and dictionary definitions, our 'forests' in fact include the pure grasslands that surround the Nilgiri *shola*, the anthropogenic grasslands in many parts of the Western Ghats, and the savannas of drier central-western India. They also include single-species teak, eucalyptus, and pine plantations developed under colonial and post-colonial forestry.

As elsewhere, Indian society has had a love-hate relationship with forests. While forests have been cleared over millennia for agriculture, and in the last two centuries also for dams, mines, and roads, they are also seen as valuable for various reasons. First, India's forests are extremely rich in biodiversity, harbouring 6 per cent of global flora and 6.5 per cent of global fauna, including 500-odd endemics, in just 1.7 per cent of the world's forests (World Conservation Monitoring Centre [WCMC] 1999). Second, these forests provide important indirect regional environmental benefits, including erosion control on steep slopes, hydrological regulation, microclimatic and regional climate regulation, and pollination services to agroecosystems (Brandon 2014). Third, these forests can be sources of timber and softwood for industrial and urban consumers.¹

Fourth, and most important in the Indian context, these forests have been historically used by the dense population in the subcontinent and continue to be directly important for the livelihoods of at least 275 million rural people (World Bank 2006). These people collect firewood, graze livestock, use timber and bamboo for construction, and harvest and sell non-timber forest products (NTFPs) and a large variety of food and medicinal plants; the last being a vital part of the livelihoods of millions

¹ Alternative sources would be private farm forestry.

of Adivasis in central and north-eastern India. Of course, the climate change debate has also highlighted the fact that forests are repositories of carbon, which means deforestation will contribute to carbon emissions, while reforestation can offset carbon emissions.

The core 'forest problematique' arises because these multiple benefits cannot be simultaneously maximized (Lele and Kurien 2011). Biodiversity conservation is only partly compatible with traditional livelihoods and not at all with plantation forestry (Hall et al. 2012). Even local use is not homogeneous: closed-canopy forests will produce less understorey grass for livestock than open-canopy forests. Similarly, use of wood as fuel is carbon neutral if harvested sustainably, but creating a net carbon sink would require banning all harvesting. Most important, these different benefits flow to different beneficiaries—local firewood collectors, nomadic graziers, downstream farmers, regional economies, or global ecotourists (Lele and Srinivasan 2013). Forests also produce 'dis-services' in the form of wildlife attack or pathogens, the costs of which are typically borne by forest-adjacent communities (Lele et al. 2013). Forest governance therefore involves taking decisions about where to prioritize which benefits, for whom, to what extent, and through what process. The last 200-odd years, beginning with establishment colonial rule, have seen a continuous contestation over precisely these questions (Lele and Menon 2014a). The introduction of carbon sequestration goals into domestic forest policy is bound to exacerbate this contestation.

Forests and Carbon Sequestration

In global climate negotiations, developed countries (the emitters of most of the carbon from fossil fuel burning) have consistently sought to put pressure on developing countries for their high deforestation rates. Unlike tropical forested countries such as Brazil or Indonesia, however, India has warded off this pressure by pointing out that its forest cover has been relatively stable (Ravindranath, Somashekhar, and Gadgil 1997).² Indeed, post 1995, official

² Countries like Brazil and Indonesia have a very high fraction of their land under forest cover, whereas in India, historical deforestation has already brought the fraction down to 20 per cent, leaving less to be deforested.

estimates claim that Indian forests are in fact net sinks of carbon (Indian Network for Climate Change Assessment [INCCA] 2010; Kishwan, Pandey, and Dadhwal 2009; Ministry of Environment, Forest and Climate Change [MoEFCC] 2012, 2015b), and several analysts claim that they have the potential to sequester much more (Singh et al. 2013).

On this basis, India has pushed for an expansion of the REDD (reducing emissions from deforestation and degradation) programme, which sought to reward countries like Brazil and Indonesia if they reduced deforestation rates, to a REDD+ programme that rewards increases in forest cover and sequestered carbon (MoEFCC 2014: Section 2.4). With the adoption of REDD+ at the 15th Conference of the Parties (COP 15) in Bali (United Nations Framework Convention on Climate Change [UNFCCC] 2008), the Indian government's actions focused on efforts towards 'REDD-readiness' (Vijge and Gupta 2014), in anticipation of large-scale international funding.³ An important component requirement for REDD is reliable measurement, reporting, and verification (MRV). The international negotiations, however, only led to draft agreements on MRV processes by 2013 (MoEFCC 2014: 22). The Indian government claims to have a robust top-down forest monitoring system (Aggarwal et al. 2009) to build this on. Other studies have argued that community-based monitoring would be cheaper (Singh, Tewari, and Phartiyal 2011). However, hardly any REDD+ projects actually got under way—only one in Meghalaya (Poffenberger 2015) has garnered payments in the voluntary carbon market.

Gradually, the policy emphasis appears to have shifted away from garnering external funds towards using internal funds for sequestration (Vijge and Gupta 2014). In its Intended Nationally Determined Contribution (INDC) for the Paris COP 21 Agreement in 2015, India committed to sequester an additional 2.5–3 billion tonnes of carbon dioxide (CO₂) equivalent in its forest sector by 2030 (MoEFCC 2015a), probably on the basis of a massive US\$ 6 billion compensatory afforestation fund (Compensatory Afforestation Fund Management and Planning Authority [CAMPA]) that has

³ One official estimate was of US\$ 3 billion over three decades (MoEFCC 2010).

accumulated (Lahiri 2015). This pledge (hereinafter INDC3) has been the subject of much public debate (Kohli and Menon 2015; Lahiri 2015; Pulla 2015). Common to debates on INDC3 and the earlier REDD+ related goals are two questions:

1. How accurate are the biophysical estimates on which claims of current net sequestration, and therefore the technical feasibility of the INDC, are based?
2. If there are biophysical (and hence social) trade-offs involved in prioritizing carbon sequestration over other forest benefits, who will decide on whether and how much to prioritize which benefits? Alternatively, what might be the socio-environmental consequences of the government trying to force a particular priority or goal at the cost of others?

Biophysical Estimates: Optimistic and Opaque

There is a divergence between academic and official estimates of current rates of carbon sequestration in India's forest sector in recent years. Official estimates range from +68 megatonnes of carbon dioxide equivalent ($\text{MtCO}_2\text{-eq/yr}$) in 2005–7 (INCCA 2010) to +203 $\text{MtCO}_2\text{-eq/yr}$ for the year 2000 (MoEFCC 2012) and +200 $\text{MtCO}_2\text{-eq/yr}$ for the year 2010 (MoEFCC 2015b). However, some academic studies estimate net sequestration to be negative, from $-185 \text{ MtCO}_2\text{-eq/yr}$ in 2005–7 (Sheikh et al. 2011) to $-198 \text{ MtCO}_2\text{-eq/yr}$ during 2005–13 (Reddy et al. 2016).⁴ The reasons for this divergence may be several. First, differences in definition of forest is one reason. Official estimates include all tree cover (including monocultural plantations in forest lands as well as horticultural crops in private lands), which results in a rising 'forest cover' trend, while only natural tree cover shows a declining trend (Reddy et al. 2016). Second, the official estimates include the amount of sequestration due to growth in forests that remained forests (termed FL-FL) and addition in carbon due to conversion of non-forest to

⁴ The academic estimates exclude changes in soil carbon, but these are anyway estimated to be negative in official estimates, so their inclusion would only increase the divergence.

forest (termed L-FL); but they appear not to include the carbon emissions from forest to non-forest transitions (termed FL-L), which are non-zero (Dubash et al. 2018). Third, there is variation within official estimates themselves: the Forest Survey of India (FSI) data show declining growing stock for most of 2003–13 in spite of stable or increasing forest cover, but national communications have come up with a positive trend (MoEFCC 2012, 2015b).

The ambitious INDC3 appears to be driven by the optimistic estimates of current net sequestration. Indeed, if India is already sequestering forest carbon at the rate of 200 MtCO₂-eq/yr, then it just needs to maintain this rate for 15 years to meet INDC3! This is because the pledge contains no claim of additionality (Grassi et al. 2017). However, the poor record of afforestation programmes in India does not lend credence to this official claim of massive net sequestration (Kohli and Menon 2015), nor does it seem plausible given the government's own estimates for 2005–7 (INCCA 2010). If in fact India's forests are net *emitters* due to ongoing degradation, then reversing the degradation and further meeting this target would require fast-growing monoculture plantations and draconian protection measures.

How can this debate about the quantum (and even the existence) of net sequestration be resolved? A persistent lacuna in the government's approach to this quantification has been the lack of transparency and credible independent verification. The FSI does not offer its forest cover maps in downloadable and usable format that can be verified or corrected by others. Nor are the data and locations of the state-funded National Carbon Pool project (Dadhwal et al. 2009: 200) available in the public domain. Given the conflict of interest in the ministry monitoring its own achievements, a more independent and transparent monitoring process is clearly required (Lele 2012).

Recognizing and Addressing the Trade-offs

Do Indian policymakers, which means primarily the MoEFCC, recognize that pursuing sequestration goals could come at the expense of other forest-related goals? There is no evidence of this recognition in government documents. As Vijge and Gupta (2014) point out, the Green India Mission (GIM), which is the key strategy for achieving

INDC3, 'does not entertain the possibility of tradeoffs' between 'carbon and non-carbon benefits of forests, such as biodiversity'.

This is part and parcel of the overall tendency in official Indian forest policy documents to gloss over trade-offs between forest-related benefits and to treat all types of forests as universally good. This tendency is already institutionalized in the FSI's forest cover monitoring strategy wherein 'forest cover' is defined as 'all lands, more than 1 hectare in area, with a *tree* canopy density of more than 10%' (FSI 2015: 25). Indeed, from a carbon perspective, forest cover and tree cover are almost interchangeable. However, as academics and activists have repeatedly pointed out, this approach clubs (for instance) single-species timber plantations with mixed-species natural forests, thereby hiding major differences in biodiversity levels and other benefits that these two types of tree covers would provide (Agarwal 1997; Davidar et al. 2010).

Consequently, the question of how these trade-offs are to be resolved, and by whom, has received almost no attention at the policy level. In the public arena, however, this (rather than the quantum of sequestration per se) has been the bigger concern with the government's pursuit of REDD+ funds and its possibly imprudent INDC3 (Aggarwal 2011). While some activists have categorically rejected carbon sequestration as a goal for community-managed forests, most argue that the decision whether and how much to focus on sequestration versus use of forests for livelihood or conservation purposes must be left to communities to make. From this perspective, the government's job is to simply make available appropriate incentives for different non-local forest benefits to become part of community decision making, to reduce the gap between carbon market prices and those reaching communities, and to bear the transaction cost of monitoring. All this, however, requires communities to have control over their forests and the authority and autonomy to make their own decisions. This is precisely what is being contested currently.

Forest governance, and specifically the role of communities in it, is currently in a state of flux in India (Lele and Menon 2014b). After decades of pursuing a colonial forest policy of exclusionary forest management, the Government of India finally acknowledged the need to involve local communities in its landmark National Forest Policy document of 1988. Joint Forest Management (JFM) was then

initiated as a programme in the early 1990s and slowly spread across most states. However, JFM failed to engender meaningful participation, even by official assessments (Environmental Impact Assessment [EIA] Division 2008). Most rigorous evaluations have found it lacking in genuine participation and becoming an instrument to further the forest departments' agenda, often in the form of monocultural plantations (for a summary, see Lele 2014).

The Forest Rights Act (FRA), 2006, is a landmark legislation that offers communities the right to manage their forests as per their needs, within a broad sustainable use and conservation norm. Villages can claim rights over all the forests that they have traditionally used (not just degraded forests as in most JFM programmes) and can make plans for their management (including harvest and sale of any/all non-timber forest produce) without reference to the forest department. This loss of day-to-day control over possibly more than half of its forest estate is naturally being resisted strongly by the forest bureaucracy. Implementation of the FRA (especially its community forest rights component) has therefore been rather slow in most states (Community Forest Rights—Learning and Advocacy [CFR-LA] 2016; Lele 2017).

What would be the implications of such community control (if and when it happens) for carbon sequestration? Observations by Lele of forest management by villages in eastern Maharashtra that have received (and are exercising) their rights suggest that forests are quite likely to be protected and even regenerated, but communities are likely to opt for natural regeneration, or planting of bamboo or other non-timber forest species, or reserving some areas for grazing or fodder plantations, resulting in a much lower rate of net carbon sequestration than in fast-growing single-species tree plantations. Could the state tilt the balance in favour of carbon forestry through a payments for ecosystem services (PES)-type scheme? In theory, yes. However, the price in the global carbon credit market (if it exists) is totally inadequate to compensate households that stand to lose fodder, fuel, and other livelihood benefits if forests are 'fenced off' for carbon (Lele 2013). The voluntary financial support for REDD+ is even more paltry, with the Green Climate Fund having garnered only 10 per cent of its target amount of 100 billion US\$ (Sunderlin et al. 2015).

Unfortunately, the GIM plan and other official reports do not engage with this question adequately. They make assumptions of a smooth transition from JFM to FRA (Sud, Sharma, and Bansal 2012: 201) or glibly talk of ‘harmonization’ of JFM with other laws (that is, the FRA), as the draft National Forest Policy, 2018 does. In reality, there is no sign that the forest bureaucracy is willing to give up control over the forest estate, that it has enjoyed for 150 years, in favour of multilayered governance. It continues to use CAMPA funds (the biggest source of afforestation funding) for conventional plantation activities on any land it chooses, notwithstanding the conflict that this has generated with local communities (Land Conflict Watch n.d.) and notwithstanding its notional commitment to participatory forest management. If carbon-centric forestry is prioritized for the sake of INDC3, then forest governance will get further re-centralized (Vijge and Gupta 2014), something predicted globally for REDD+ as well (Phelps, Webb, and Agrawal 2010). Resolving the governance issue will be crucial to improving the synergies and reducing trade-offs between carbon sequestration, local livelihoods, and conservation, and for seeing lasting impacts on the ground.

Forests and Other Climate Impacts

Change in forest cover not only influences atmospheric carbon stocks, but can impact both albedo and evapotranspiration that can have local, regional, and global impacts depending on the location and scale of the change. Here, we summarize briefly what is known about the role of forests in rainfall in South Asia.

There is growing evidence from direct observations and modelling across the globe about the positive (or negative) impact of forest cover (or deforestation) on rainfall through recycling of evapotranspiration and other mechanisms (Bonan 2008; Spracklen, Arnold, and Taylor 2012). This has, however, been demonstrated unambiguously only for large forested regions, such as the Amazon and Congo basins. In India, Meher-Homji (1991) first drew attention to the influence of forest on rainfall and microclimate, using simplistic (and possibly unconvincing) correlation analysis in the absence of detailed data and modelling tools.

Recently, however, three studies have simulated the likely impacts of deforestation—*outside* and *within* India—on rainfall in India, covering both the Western Ghats and north-east India (Devaraju, Bala, and Modak 2015; Paul et al. 2016, 2018). They suggest significant connections: for example, the contribution of Western Ghats forests to summer rainfall in Tamil Nadu plains is estimated to be 25–40 per cent, adding a significant new dimension to the ecosystem services of the Western Ghats forests. Although these studies suffer from several limitations,⁵ it appears that there is some evidence that, despite major decline in forested area over the last century, India's forests play some role in recirculating moisture and thereby adding to precipitation in the subcontinent. This strengthens the argument for conserving forests, but the questions about who decides and who maintains what kind of forests, and so on, remain.

Impact of Climate Change on India's Forests

Although conserving or even enhancing India's forest cover may not make a big dent in global carbon emissions, India's forests, their inhabitants, and their users, are likely to be affected by climate change in complex and as yet unclear ways. This uncertainty is a combination of the uncertainties around how climatic conditions will shift and about how forest vegetation and wildlife in it might respond to these shifts.

Possible Impacts on Forests

In trying to predict impacts on forest vegetation, scientists have focused on different (broad) outcome variables: forest productivity and standing stock; soil carbon stocks; and the broad type of plant–animal community that may occur in a particular area, that is,

⁵ Such as use of inaccurate land cover classification, questionable assumptions about evapotranspiration being minimal from the Western Ghats forests in the dry season, and a focus on the south-west monsoon when Tamil Nadu receives much of its rain from the north-east monsoon.

biome.⁶ The methods of prediction vary from using historical data on vegetation response to climate shifts as a surrogate, to building statistical models linking current vegetation distribution to current climate, to building more realistic but complex models of multiple biophysical processes including photosynthesis, leaf growth, and so on, to empirically correlating field observations of plant growth over last few decades (perhaps aided by remote sensing) with climatic trends during this period. All of them, of course, hinge on how well future climate is predicted and which of those variables (not just temperature, rainfall, and atmospheric carbon, but also extreme events, summer temperatures, rainfall in particular seasons, soil moisture stress, among others) are incorporated into the forest–climate model. Predicting impacts on animals is more complicated, because they are mobile and their presence depends upon vegetative conditions as well as climatic conditions.

Initial studies on ‘biome shifts’ characterized climate primarily in terms of average temperature, average rainfall, and CO₂ concentrations. Using the differential manner of carbon isotope absorption in plants with different photosynthetic pathways, a study in the Nilgiri sholas of the southern Western Ghats (Sukumar, Suresh, and Ramesh 1995) suggested that under higher CO₂ and moisture conditions, an expansion of montane forest and a shift in the composition of grassland species can be expected. Subsequent studies grappled with conflicting predictions about the direction of climatic shifts, giving rise to different conclusions about whether forest productivity would increase and forests’ vegetation would shift to moister types or whether drier types of forest would expand and tree mortality might increase because of decreasing rainfall and soil moisture (Ravindranath and Sukumar 1998).

More recent studies that use more sophisticated regional climate models and process-based vegetation models suggest that over 70 per cent of India’s forests would shift towards moister forest types

⁶ Biomes are ‘distinct biological communities that have formed in response to a shared physical climate’ (<https://en.wikipedia.org/wiki/Biome>). One popular classification of world biomes recognizes 11 major biomes in India (the World Wildlife Fund ecoregions maps, quoted in Rasquinha and Sankaran [2016]).

under enhanced CO₂ levels and future climate (Chaturvedi et al. 2011; Ravindranath, Sukumar, and Saxena 2006). Correlation-based approaches (Rasquinha and Sankaran 2016) predict less dramatic changes, but they seem to agree that the extent of the tropical and subtropical moist broadleaf forest biome (which includes wet evergreen and moist deciduous forests) is likely to increase, whereas the Himalayan temperate broadleaf forests (oak) may see the most reduction in area.

That the Himalayan forests may be affected significantly appears to be corroborated by recent trends. These mountains already have the highest rates of warming globally (Shrestha, Gautam, and Bawa 2012). A remote sensing-based study highlighted ongoing temperature-induced moisture stress and the resultant browning of vegetation in certain elevation bands (Krishnaswamy, John, and Joseph 2014). This browning is corroborated by ground measurements (Singh et al. 2000; Singh, Singh, and Skutsch 2010). Higher elevation trees, such as the Himalayan birch, that survive on water from snowmelt may be most vulnerable to the warming trend (Liang et al. 2014).

The other biome that may shrink significantly is the one containing desert and semi-arid grasslands. Large areas of this biome have already become wooded because of introduction of invasive species such as *Prosopis*. The wetting trend predicted by most climate models will further shrink this biome (Rasquinha and Sankaran 2016). However, the presence of *Prosopis* also alerts us to the fact that anthropogenic influences may in some places exacerbate and in other places limit the influence of climate change. For instance, in the Western Ghats, the predicted shift from dry deciduous to moist deciduous forest may be limited by the presence of another invasive species (*Lantana*) (Hiremath and Sundaram 2005) and ongoing changes due to fire and fragmentation (Kodandapani, Cochrane, and Sukumar 2004).

In terms of other outcomes, current studies all point to increases in productivity, ranging from 50 per cent to 70 per cent (Chaturvedi et al. 2011) or 70 per cent to 100 per cent (Ravindranath, Sukumar, and Saxena 2006), and consequently in above-ground biomass, by about 17 per cent of India's current estimated above-ground carbon stock (Chaturvedi et al. 2011; Chhabra and Dadhwal 2004; Ravindranath, Somashekhar, and Gadgil 1997).

However, these estimates need to be treated with caution as they miss out on many variables, both biophysical (other climatic variables, soil variables, and so on) and anthropogenic (how forests are actually used and managed). On the biophysical side, the climate models themselves are quite incomplete. Downscaling global climate models to regional climate models is particularly unreliable in the Indian context, because such approaches do a poor job of predicting the outcome of the Indian monsoon. Nor do these predictions tell us much about unique moisture regimes, such as cloud stripping or fog and mist in the winter. Moreover, the vegetative response to changes in conditions may be non-linear. For instance, the only rigorous experimental study of thermotolerance of forest trees reveals that upper limits of leaf functions are critically close to observed maximum temperature (Sastry, Guha, and Barua 2018). On the social side, gross changes in productivity may matter little if livelihood-relevant species, such as *Diospyros melanoxylon* (tendu) in central India, disappear as the forest becomes wetter.

Possible Impacts on Wildlife

Climate change can affect wildlife in general or individual species by changing their habitat, disrupting ecological linkages, or directly threatening their survival. Traits that make species sensitive to climate change include factors such as: dependence on specialized habitat; life cycle stages tightly coupled with temperature or moisture thresholds; dependence on environmental triggers for initiating life cycle functions or dependence of inter-specific interactions; and rarity.

Some of the candidate species that fit these criteria are: the grizzled giant squirrel (*Ratufa macroura*) that prefers riparian forests in dry zones (Seavy et al. 2009); the snow leopard (*Panthera uncia*) that is restricted to a particular (high) elevation band (Forrest et al. 2012) in the Himalayas; and the blue sheep (*Pseudois nayaaur*) (Aryal et al. 2016), a prey species for the snow leopard, and the Nilgiri tahr (*Nilgiritragus hylocrius*) (Sony et al. 2018). For instance, it is estimated that 30 per cent of snow leopard habitat may be lost due to a shifting treeline and consequent shrinking of the alpine zone. An extreme example of a species that could be severely affected in a specific pocket is the tiger (*Panthera tigris*) in the Sunderbans mangrove.

It is estimated that with a predicted 28-cm rise in sea-level over the next 50–90 years (as compared to the levels in the year 2000), the remaining tiger habitat in Bangladesh's Sundarbans would decline by 96 per cent (Loucks et al. 2010). Thus, the tigers of the Sundarbans in India and Bangladesh may soon join the Arctic's polar bears as early victims of climate change-induced habitat loss.

Nevertheless, major uncertainties remain. The ability of animals to migrate when biomes shift will depend upon the connectivity of their older and newer habitats. The study of blue sheep also points to the complexity introduced by prey–predator relationships—if the snow leopard population declines, will its prey increase even though climate change may make conditions more unsuitable for the sheep?

In short, the currently available coarse climate models and the limited understanding of plant, and even more so animal, responses seriously limits what can be said about the long-term impacts of climate change, and especially about its implications for forest-based livelihoods and economies, whether based on products or on wildlife tourism.

Forests are complex socio-ecological entities as they provide multiple benefits to multiple stakeholders at different scales, from local to global. In recent times, with the emergence of climate change as the 'mother of all environmental problems', the forest question has often been narrowly framed as the forest carbon question. This is problematic in general, and particularly so in India, 'where forests have been settled and used by forest-dwelling communities for centuries, whether in the Himalayas, Western Ghats, or central or north-eastern India, and they are not only enormously rich in biodiversity but also play a critical role in regulating the hydrology of rivers. As we explore the forest–climate link, it is therefore important to keep this broad picture in mind. This then directs our attention to the multiple ways in which climate and forests are connected: forests for climate mitigation; forests in regional rainfall and climate processes; and the reverse impacts of climate change on forests, forest-based wildlife, and forest-dependent people.

The social history and context of India's forests, when coupled with this ecological understanding of climate and non-climate processes, also alerts us to the fact that forests are a highly contested 'resource' in India. Who makes decisions about forests, and how, will have multidimensional implications, not just for the carbon sequestered and India's INDC3, but for the health of the forest ecosystems and the people dependent upon them, including the resilience of these socio-ecological systems to the imminent impacts of climate change.

In this context, researchers must not just work on developing finer resolution climate models and incorporating more ecological variables in impact studies, but must also focus on more socially relevant impact variables. Further, in sequestration studies, they must complement better forest growth models and sequestration data with multi-dimensional analysis of the outcomes of different sequestration strategies for forest-based livelihoods, watershed services, and biodiversity.

Policymakers will have to confront the question of whether they want to follow business-as-usual approaches in which the centralizing tendencies in forest governance reassert themselves, or whether alternative models of decentralized, community-based, multi-objective forestry might be promoted as a longer term and environmentally more just solution.

References

- Agarwal, A. 1997. 'Dark Truths and Lost Woods', *Down to Earth*, 15 June, pp. 32–40.
- Aggarwal, A. 2011. 'Implementation of Forest Rights Act, Changing Forest Landscape, and "Politics of REDD+" in India', *Journal of Resources, Energy and Development*, 8(2): 131–48.
- Aggarwal, Ashish, Soumitri Das, and Paul Varghese. 2009. 'Is India Ready to Implement REDD Plus? A Preliminary Assessment', Discussion Paper, The Energy and Resources Institute, New Delhi.
- Aryal, A., U.B. Shrestha, W. Ji, S.B. Ale, S. Shrestha, T. Ingty, T. Maraseni, G. Cockfield, D. Raubenheimer. 2016. 'Predicting the Distributions of Predator (Snow Leopard) and Prey (Blue Sheep) under Climate Change in the Himalaya', *Ecology and Evolution*, 6: 4065–75.
- Bonan, Gordon B. 2008. 'Forests and Climate Change: Forcings, Feedbacks, and the Climate Benefits of Forests', *Science*, 320(5882): 1444–9.

- Brandon, K. 2014. 'Ecosystem Services from Tropical Forests: Review of Current Science', Working Paper 380, Climate and Forest Paper Series #7, Center for Global Development, Washington, DC.
- Chaturvedi, Rajiv K., Ranjith Gopalakrishnan, Mathangi Jayaraman, Govindasamy Bala, N.V. Joshi, Raman Sukumar, and N. H. Ravindranath. 2011. 'Impact of Climate Change on Indian Forests: A Dynamic Vegetation Modeling Approach', *Mitigation and Adaptation Strategies for Global Change*, 16(2): 119–42.
- Chhabra, Abha and V.K. Dadhwal. 2004. 'Assessment of Major Pools and Fluxes of Carbon in Indian Forests', *Climatic Change*, 64(3): 341–60.
- Community Forest Rights—Learning and Advocacy (CFR-LA). 2016. 'Promise and Performance: Ten Years of the Forest Rights Act in India', Citizens' Report, CFR-LA, India. Available at <http://cfsla.org.in/resources/citizens%20report%202015.pdf>.
- Dadhwal, V.K., S. Singh, and P. Patil. 2009. 'Assessment of Phytomass Carbon Pools in Forest Ecosystems in India', *NNRMS Bulletin*. Available at http://www.academia.edu/download/35026248/NNRMS_Bulletin_pages_41-57.pdf; accessed 20 September 2017.
- Davidar, Priya, Sasmita Sahoo, Pratheesh C. Mammen, Prashanth Acharya, Jean-Philippe Puyravaud, M. Arjunan, Jean Pierre Garrigues, and Krista Roessingh. 2010. 'Assessing the Extent and Causes of Forest Degradation in India: Where Do We Stand?', *Biological Conservation*, 143(12): 2937–44.
- Devaraju, N., G. Bala, and A. Modak. 2015. 'Effects of Large-Scale Deforestation on Precipitation in the Monsoon Regions: Remote versus Local Effects', *Proceedings of the National Academy of Sciences*, 112(11): 3257–62.
- Dubash, Navroz K., Radhika Khosla, Ulka Kelkar, and Sharachchandra Lele. 2018. 'India and Climate Change: Evolving Ideas and Increasing Policy Engagement', *Annual Review of Environment and Resources*, 43(2018): 395–424.
- Environmental Impact Assessment (EIA) Division. 2008. 'Mid-Term Evaluation of the National Afforestation Programme (NAP) Schemes Implemented through Forest Development Agencies (FDAs)', National Afforestation and Ecodevelopment Board, Ministry of Environment and Forests, Government of India, New Delhi. Available at http://www.naeb.nic.in/MTE-Complete_Report.pdf.
- Forest Survey of India (FSI). 2015. *India State of Forest 2015*. Dehradun: Ministry of Environment, Forest and Climate Change.
- Forrest, J.L., E. Wikramanayake, R. Shrestha, G. Areendran, K. Gyeltshen, A. Maheshwari, S. Mazumdar, R. Naidoo, G.J. Thapa, K. Thapa. 2012.

- 'Conservation and Climate Change: Assessing the Vulnerability of Snow Leopard Habitat to Treeline Shift in the Himalaya', *Biological Conservation*, 150: 129–35.
- Grassi, Giacomo, Jo House, Frank Dentener, Sandro Federici, Michel den Elzen, and Jim Penman. 2017. 'The Key Role of Forests in Meeting Climate Targets Requires Science for Credible Mitigation', *Nature Climate Change*, 7(3): 220–6.
- Hall, Jaclyn M., Tracy Van Holt, Amy E. Daniels, Vincent Balthazar, and Eric F. Lambin. 2012. 'Trade-offs between Tree Cover, Carbon Storage and Floristic Biodiversity in Reforesting Landscapes', *Landscape Ecology*, 27(8): 1135–47.
- Hiremath, Ankila J. and Bharath Sundaram. 2005. 'The Fire-Lantana Cycle Hypothesis in Indian Forests', *Conservation and Society*, 3(1): 26–42.
- Indian Network for Climate Change Assessment (INCCA). 2010. *India: Greenhouse Gas Emissions 2007*. New Delhi: INCCA, Ministry of Environment and Forests, Government of India. Available at http://www.moef.gov.in/sites/default/files/Report_INCCA_0.pdf.
- Kishwan, J., R. Pandey, and V.K. Dadhwal. 2009. 'India's Forest and Tree Cover: Contribution as a Carbon Sink', Technical Paper. Dehradun: Indian Council for Forest Education and Research (ICFRE), Ministry of Environment and Forest.
- Kodandapani, Narendran, Mark A. Cochrane, and R. Sukumar. 2004. 'Conservation Threat of Increasing Fire Frequencies in the Western Ghats, India', *Conservation Biology*, 18(6): 1553–61.
- Kohli, K. and M. Menon. 2015. 'Growing Forests in the Air', *The Hindu*, 26 October. Available at <http://www.thehindu.com/opinion/columns/future-forecast-column-growing-forests-in-the-air/article7802930.ece>.
- Krishnaswamy, Jagdish, Robert John, and Shijo Joseph. 2014. 'Consistent Response of Vegetation Dynamics to Recent Climate Change in Tropical Mountain Regions', *Global Change Biology*, 20(1): 203–15.
- Lahiri, S. 2015. 'What India's INDC Does Not Tell You about Its Forests', Global Forest Coalition, 1 December. Available at <http://globalforestcoalition.org/indias-indc-not-tell-forests/>; accessed on 28 December 2017.
- Land Conflict Watch. n.d. 'Conflicts'. Available at <https://www.landconflictwatch.org/node/498/67/all/all/all/all>; accessed on 11 January 2019.
- Lele, S. 2012. 'Standalone Agency to Map Green Wealth', *The Economic Times*, 12 May. Available at <http://economictimes.indiatimes.com/opinion/comments-analysis/how-to-arrest-forest-degradation/article-show/13104106.cms>.
- . 2013. 'Buying Our Way Out of Environmental Problems?', *Current Conservation*, 6: 9–13.

- _____. 2014. 'What Is Wrong with Joint Forest Management?', in S. Lele and A. Menon (eds), *Democratizing Forest Governance in India*, pp. 25–62. New Delhi: Oxford University Press.
- _____. 2017. 'Forest Governance: From Co-option and Conflict to Multilayered Governance?', *Economic & Political Weekly*, 52(25–6): 55–8.
- Lele, Sharachchandra and Amit Kurien. 2011. 'Interdisciplinary Analysis of the Environment: Insights from Tropical Forest Research', *Environmental Conservation*, 38(2): 211–33.
- Lele, S. and A. Menon. 2014a. 'Introduction: Forest Governance beyond Joint Forest Management, Godavarman, and Tigers', in S. Lele and A. Menon (eds), *Democratizing Forest Governance in India*, pp. 1–22. New Delhi: Oxford University Press.
- _____. (eds). 2014b. *Democratizing Forest Governance in India*. New Delhi: Oxford University Press.
- Lele, Sharachchandra, Oliver Springate-Baginski, Roan Lakerveld, Debal Deb, and Prasad Dash. 2013. 'Ecosystem Services: Origins, Contributions, Pitfalls, and Alternatives', *Conservation and Society*, 11(4): 343–58.
- Lele, Sharachchandra and Veena Srinivasan. 2013. 'Disaggregated Economic Impact Analysis Incorporating Ecological and Social Trade-offs and Techno-institutional Context: A Case from the Western Ghats of India', *Ecological Economics*, 91(July): 98–112.
- Liang, Eryuan, Binod Dawadi, Neil Pederson, and Dieter Eckstein. 2014. 'Is the Growth of Birch at the Upper Timberline in the Himalayas Limited by Moisture or by Temperature?', *Ecology*, 95(9): 2453–65.
- Loucks, C., S. Barber-Meyer, M.A.A. Hossain, A. Barlow, R.M. Chowdhury. 2010. 'Sea-Level Rise and Tigers: Predicted Impacts to Bangladesh's Sundarbans Mangroves'. *Climatic Change* 98: 291.
- Meher-Homji, V.M. 1991. 'Probable Impact of Deforestation on Hydrological Processes', *Climatic Change* 19(1–2): 163–73.
- Ministry of Environment, Forest and Climate Change (MoEFCC). 2010. 'India's Forests and REDD+', MoEFCC, Government of India, New Delhi.
- _____. 2012. 'India: Second National Communication to the UNFCCC', MoEFCC, Government of India, New Delhi.
- _____. 2014. 'Reference Document for REDD+ in India', MoEFCC, Government of India, New Delhi.
- _____. 2015a. 'India's Intended Nationally Determined Contribution: Working towards Climate Justice', Government of India, New Delhi. Available at <http://www4.unfccc.int/ndcregistry/PublishedDocuments/>

- India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf; accessed on 21 November 2017.
- . 2015b. 'India: First Biennial Update Report to the United Nations Framework Convention on Climate Change', MoEFCC, Government of India, New Delhi. Available at <http://unfccc.int/resource/docs/natc/indbur1.pdf>; accessed on 29 December 2017.
- Paul, Supantha, Subimal Ghosh, Robert Oglesby, Amey Pathak, Anita Chandrasekharan, and R.A.A.J. Ramsankaran. 2016. 'Weakening of Indian Summer Monsoon Rainfall due to Changes in Land Use Land Cover', *Scientific Reports*, 6: 32177.
- Paul, Supantha, Subimal Ghosh, K. Rajendran, and Raghu Murtugudde. 2018. 'Moisture Supply from the Western Ghats Forests to Water Deficit East Coast of India', *Geophysical Research Letters*, 45(9): 4337–44.
- Phelps, Jacob, Edward L. Webb, and Arun Agrawal. 2010. 'Does REDD+ Threaten to Recentralize Forest Governance?', *Science*, 328(5976): 312–13.
- Poffenberger, M. 2015. 'Restoring and Conserving Khasi Forests: A Community-Based REDD Strategy from Northeast India', *Forests*, 6(12): 4477–94.
- Pulla, P. 2015. 'Can India Keep Its Promises?', *Science*, 350(6264): 1024–7.
- Rasquinha, D.N. and M. Sankaran. 2016. 'Modelling Biome Shifts in the Indian Subcontinent under Scenarios of Future Climate Change', *Current Science*, 111(1): 147–56.
- Ravindranath, N.H., N.V. Joshi, R. Sukumar, and A. Saxena. 2006. 'Impact of Climate Change on Forests in India', *Current Science*, 90(3): 354–61.
- Ravindranath, N.H., B.S. Somashekhar, and Madhav Gadgil. 1997. 'Carbon Flow in Indian forests', *Climatic Change*, 35(3): 297–320.
- Ravindranath, N.H. and R. Sukumar. 1998. 'Climate Change and Tropical Forests in India', *Climatic Change*, 39: 563–81.
- Reddy, C. Sudhakar, F. Rakesh, C.S. Jha, K. Athira, Sonali Singh, V.V.L. Padma Alekhya, G. Rajashekar, P.G. Diwakar, and V.K. Dadhwal. 2016. 'Geospatial Assessment of Long-Term Changes in Carbon Stocks and Fluxes in Forests of India (1930–2013)', *Global and Planetary Change*, 143(Suppl. C): 50–65.
- Sastry, Aniruddh, Anirban Guha, and Deepak Barua. 2018. 'Leaf Thermotolerance in Dry Tropical Forest Tree Species: Relationships with Leaf Traits and Effects of Drought', *AoB Plants* 10(1): plx070. Available at <https://doi.org/10.1093/aobpla/plx070>.
- Seavy, Nathaniel E., Thomas Gardali, Gregory H. Golet, F. Thomas Griggs, Christine A. Howell, Rodd Kelsey, Stacy L. Small, Joshua H. Viers, and James F. Weigand. 2009. 'Why Climate Change Makes Riparian

- Restoration More Important than Ever: Recommendations for Practice and Research', *Ecological Restoration*, 27(3): 330–8.
- Sheikh, Mehraj A., Munesh Kumar, Rainer W. Bussman, and N.P. Todaria. 2011. 'Forest Carbon Stocks and Fluxes in Physiographic Zones of India', *Carbon Balance and Management*, 6(1): 1–10.
- Shrestha, Uttam Babu, Shiva Gautam, and Kamaljit S. Bawa. 2012. 'Widespread Climate Change in the Himalayas and Associated Changes in Local Ecosystems.' *PLoS One*, 7(5): e36741.
- Singh, Anju, Seema Unnikrishnan, Neelima Naik, and Kavita Duvvuri. 2013. 'Role of India's Forests in Climate Change Mitigation through the CDM and REDD+', *Journal of Environmental Planning and Management*, 56(1): 61–87.
- Singh, Surendra P., Ashish Tewari, Shirish K. Singh, and Girish C. Pathak. 2000. 'Significance of Phenologically Asynchronous Populations of the Central Himalayan Oaks in Drought Adaptation', *Current Science*, 79 (3): 353–7.
- Singh, Surendra P., Vishal Singh, and Margaret Skutsch. 2010. 'Rapid Warming in the Himalayas: Ecosystem Responses and Development Options', *Climate and Development*, 2(3): 221–32.
- Singh, Surendra P., Ashish Tewari, and Pushkin Phartiyal. 2011. 'Community Carbon Forestry to Counter Forest Degradation in the Indian Himalayas', in Margaret Skutsch (ed.), *Community Forest Monitoring for Carbon Market: Opportunities under REDD*, pp. 118–33. London, UK: Earthscan.
- Sony, R., S. Sen, S. Kumar, M. Sen, and K. Jayahari. 2018. 'Niche Models Inform the Effects of Climate Change on the Endangered Nilgiri Tahr (*Nilgiritragus hylocrius*) Populations in the Southern Western Ghats, India'. *Ecological Engineering*, 120: 355–63.
- Spracklen, Dominick V., Steve R. Arnold, and C.M. Taylor. 2012. 'Observations of Increased Tropical Rainfall Preceded by Air Passage Over Forests', *Nature*, 489(7415): 282.
- Sud, R., J.V. Sharma, and A.K. Bansal. 2012. 'International REDD+ Architecture and Its Relevance for India', Ministry of Environment and Forests, Government of India, and TERI, New Delhi.
- Sukumar, R., H.S. Suresh, and R. Ramesh. 1995. 'Climate Change and Its Impact on Tropical Montane Ecosystems in Southern India', *Journal of Biogeography*: 533–6.
- Sunderlin, W., E. Sills, A. Duchelle, A. Ekaputri, D. Kweka, M. Toniolo, S. Ball, N. Doggart, C. Pratama, and J. Padilla. 2015. 'REDD+ at a Critical Juncture: Assessing the Limits of Polycentric Governance for Achieving Climate Change Mitigation', *International Forestry Review*, 17: 400–13.

- United Nations Framework Convention on Climate Change (UNFCCC). 2008. 'Report of the Conference of the Parties on Its Thirteenth Session, Held in Bali from 3 to 15 December 2007: Decisions Adopted by the Conference of the Parties', FCCC/CP/2007/6/Add.1, UNFCCC, Geneva.
- Vijge, Marjanneke J. and Aarti Gupta. 2014. 'Framing REDD+ in India: Carbonizing and Centralizing Indian Forest Governance?', *Environmental Science & Policy*, 38(April): 17–27.
- World Bank. 2006. 'India: Unlocking Opportunities for Forest-Dependent People in India: Main Report: Volume I. No. 34481-IN'. New Delhi: Agriculture and Rural Development Sector Unit, South Asia Region, The World Bank.
- World Conservation Monitoring Centre (WCMC). 1999. 'Biodiversity Profile of India', UNEP-WCMC, Cambridge, UK.

Climate Adaptation in the Water Sector in India

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The *Fifth Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC) shows that climate change is likely to directly impact the water sector (IPCC 2014; also see Bates et al. 2008). Climate change may affect both the short-term variability of water resources through increased frequency and intensity of droughts and floods or induce long-term changes in mean renewable water supply. Climate change may also induce behavioural changes, which may in turn impact water demand. However, evidence from empirical research on climate adaptation suggests that climate change is not the only stressor and resilience is not the only concern. Instead, an approach that accounts for multiple stressors, multiple concerns, and missing linkages across scales is needed.

Impact of Climate Change in the Water Sector

Impact of Climate Change on Hydroclimatic Variables

Assessments of the impact of a changing climate on water resources typically involves the applications of chains of models through: (i)

downscaling and bias correcting the output of the general circulation models (GCMs) to project hydroclimatic variables; and (ii) evaluating the impacts of the climate projections using hydrological models.

The scholarly evidence on the impact of climate change on hydroclimatic factors can broadly be divided into two literatures: 'empirical statistical analyses' of past trends in observed precipitation, temperature, soil moisture, stream flow, and so on; and 'model-based projections' of future trends in these variables. Surprisingly, these are not always in sync.

There is reasonable consistency in temperature projections under climate change and historical trends. Maximum temperature in India has increased in most parts of south, central, and west India. The rise in annual mean temperature over India is comparable with the reported rise of global surface temperature by 0.6°C (Jones et al. 1999), although a few stations exhibit declining trends in the north and north-east (Jain and Kumar 2012; Jaswal, Rao, and Singh 2015). However, as Jain and Kumar (2012) point out, many stations are in the proximity of settled areas, so the urban heat island effect cannot be separated from the impact of global climate change. Rising temperatures may impact human demand for water. Temperature, however, also affects supply, altering the hydrologic cycle by increasing evaporation and evapotranspirative demand by vegetation.

In the case of rainfall, however, the trends remain confusing. There is some support for the hypothesis that the frequency and intensity of extreme rainfall events over India has been increasing over the last century (Guhathakurta, Sreejith, and Menon 2011; Krishnamurthy, Lall, and Kwon 2009). In the case of the Himalayan snowpack, the models and observation records both indicate a continued trend of less snow, more rain, and more evaporation under a warmer climate. Melting snow and ice contribute an estimated 70 per cent of summer flow in the main Ganges in the dry season (Xu et al. 2009). Although the processes determining the conversion of glaciers, ice, and snow into run-off and stream flow are not completely understood, climate change is expected to substantially alter flow regimes in Himalayan rivers (Xu et al. 2009). While increased melting of glaciers may initially increase stream flow, in the long run, as glaciers shrink or approach new equilibria, increasing dry-season water shortages are likely to occur downstream.

There remain, however, inconsistencies between the models and past trends when it comes to rainfall and a consistent picture has not emerged (Jain and Kumar 2012). Most climate models predict intensification of the Indian monsoon and *increases* in precipitation in many parts of India. On the subject of the Indian monsoon, the IPCC *Fifth Assessment Report* projects a general increase in seasonal mean rainfall over India, but an increase in intense rainfall events at the expense of weaker rainfall events over the central Indian region, among other areas, and longer dry spells. The extreme events are attributed to the enhanced moisture content or warmer sea surface temperatures (SSTs) in the tropical Indian Ocean. These increases are likely to be unevenly distributed. Further, while monsoon onset dates are likely to be earlier or unchanged, the monsoon retreat dates are likely to be delayed, resulting in lengthening of the monsoon season (IPCC 2014).

The problem is that even as the climate models predict increases in precipitation, many studies of observed rainfall trends suggest the opposite, that is, there has been a weakening in seasonal rainfall in some regions and a regional redistribution. These discrepancies have been attributed to local factors, such as changes in black carbon and aerosols, land use, and SSTs, that are poorly incorporated in climate models (IPCC 2014; Saha et al. 2014). This suggests that understanding the possible changes in the Indian monsoon under global warming remains a major challenge in climate science, as even state-of-the-art GCMs show poor skill in reconstructing the observed historical trends and intra-annual variability in precipitation (Saha et al. 2014).

Impact of Hydroclimatic Variables on Water Supply

Water resources planning and development requires an ability to predict the likely direction and magnitude of changes to future ground and surface water flow (Kumar 2011), but these efforts in India are stymied by our inability to generate consistent projections of precipitation.

Probabilistic assessments are central to water management and design of water systems because of the variable nature of climatic patterns. Traditionally, water resources assessments have assumed

‘stationarity’, that is, natural systems fluctuate within an unchanging envelope of variability both in terms of rainfall and stream flow. This principle was used to design infrastructure and policies. For instance, dams, inter-state water-sharing agreements, and storm water drains are all designed based on ideas of a ‘basin yield’ and a ‘100-year storm’. While it is clear that the assumption of stationarity is unlikely to hold in the future (Milly et al. 2008), uncertainties in the hydro-climatic impacts of climate change pose a challenge in river basin models. As a result, most studies merely assume more variability.

A number of studies have attempted to translate the projected changes in precipitation to changes in run-off and groundwater recharge. However, the task of determining cause and effect with respect to hydrologic behaviour is complicated in India due to sparse hydrologic records and human modifications. Lack of data not only confounds the formulation of quantitative models, but also hampers the development of conceptual models of ‘how the river basin works’. As models rarely account for human impacts, any decrease in the stream flow in the recent past is often attributed entirely to a ‘climate signal’ (Ghosh, Raje, and Mujumdar 2010), essentially precluding the possibility of proximate influences like groundwater pumping.

In the absence of reliable historical records of climate, water, and human activity, models relying on conventional data sources often make unrealistic assumptions or oversimplifications, resulting in questionable predictions. The vast majority of existing studies use off-the-shelf basin-scale models like SWAT (Soil and Water Assessment Tool) and VIC (Variable Infiltration Capacity) to test future scenarios (Narsimlu, Gosain, and Chahar 2013; Patel and Nandhakumar 2016; Paul et al. 2015). For instance, a study by Gosain, Rao, and Basuray (2006) modelled the water availability in space and time in several Indian river basins under climate change. However, the models did not incorporate any man-made structures like dams and diversions.

Indeed, operational data on reservoirs is hard to obtain and, in many cases, the data have not even been digitized. Most models do not allow for coupling of surface water to deep groundwater resources, and this effectively decouples any effects of groundwater mining from surface water responses. The cumulative impact of small-scale interventions such as check dams, farm bunds, and drip irrigation are completely neglected, despite widespread evidence that

they drastically alter stream flow and recharge regimes (Batchelor, Rama Mohan Rao, and Manohar Rao 2003; Glendenning et al. 2012).

In summary, predictions of water availability under climate change remain highly questionable. Not only are rainfall projections themselves inconsistent (across climate models and when compared with historical data), the translation of rainfall into run-off and recharge is even harder, because watersheds in India have been so drastically altered by human activity. Much more primary research is needed to fully understand the impacts of ‘multiple stressors’ (Lele et al. 2018). A fundamental unsolved challenge in hydrology remains in predicting the future trajectory of human actions in terms of land use, crops, technology, and infrastructure; new approaches are needed that are able to consider alternative water futures and incorporate these into models (Srinivasan et al. 2017).

Limitations of the Current Framework and Way Forward

Current framing of climate adaptation in the water sector has been largely inadequate for several reasons. To help address these, climate adaptation in the water sector should explicitly acknowledge the existence of multiple concerns and multiple stressors at the outset, and also seek ways of linking basin-scale analysis to individual actions via infrastructure and institutions where appropriate (Srinivasan et al. 2013).

Climate Resilience Is Not the Only Concern, Agencies Have Multiple Concerns

As climate change is predicted to impact extreme events, the focus of many studies has been on droughts and floods. This narrow focus may be reasonable in a temperate, developed country context, where issues of water scarcity, water quality and, to a much more limited extent, sustainability, have been largely resolved over a century of development and many decades of relatively stable populations. In the face of potentially dramatic shifts in climate, the major goal for these regions has to be to adapt and/or build resilience so as to maintain their (high) level of water availability or water service (Lele et al. 2018). This, however, does not hold true for developing countries,

where the goals of adequacy, quality, or sustainability (among others) are far from being met.

Existing problems in water provisioning in developing countries are not adequately captured by the framing of climate change as the primary driver and vulnerability/non-resilience as the primary concern. For instance, median per capita water availability in Indian cities is a mere 69 litre per capita per day (LPCD) and is highly inequitably distributed (Indian Institute for Human Settlements 2014) compared to 310 LPCD in the United States (US) in 2015 (Dieter and Maupin 2017). Groundwater resources are depleting rapidly (Shah 2010), raising concerns about the well-being of future generations. At the same time, water quality is declining. The water quality in majority of surface water bodies and water treatment infrastructure are inadequate and deteriorating, resulting in public health crises.

This poses a problem when it comes to bridging the gap between academic research and policy practice—climate adaption research cannot be separated from general water and sanitation sector debates; and there are few win-wins as often satisfying one objective occurs at the expense of another. Explicit formulation of the trade-offs and synergies between different normative goals therefore becomes critical to avoid unintended consequences (Lele et al. 2018). An integrative approach is needed that can recognize multiple normative concerns, such as developing, allocating, and managing water equitably and efficiently; ensuring resource and financial sustainability; making progress towards Sustainable Development Goals (SDGs); following good governance principles, including stakeholder participation; and ensuring environmental quality.

Climate Change Is Not the Only Stressor; Need to Incorporate Multiple Stressors

Is climate change the most important stressor acting on the water resource system, now and will it be so in the future? In economically developed, temperate countries with low population growth and relative stable land use, it does seem likely that climate may already be the main stressor. However, in India, rapid growth of urban populations combines with intensifying agriculture, industrial growth, and rising incomes that increase the demand for fresh water in multiple

ways that are far more immediate, and are likely to dominate the climate change effect, at least for now.

Human interventions are increasingly recognized as undermining the assumption of stationarity. Dams, groundwater extraction, watershed interventions, and land use–land cover change are all altering flows. While climate change will alter precipitation and evapotranspiration, human water abstraction is likely to remain the principal contributor to reduced freshwater flows globally (Grafton et al. 2013; Vorosmarty 2000;). Indeed, in India, the business-as-usual scenario, based on the recent trends in population and agriculture growth, projects a 40 per cent increase in groundwater withdrawals (Amarasinghe et al. 2007).

The problem is that acknowledgement of anthropogenic influences on water resources models (and consequently policy) in India remains rare. In many cases, even large infrastructure projects are not factored in, let alone the effects of small, decentralized anthropogenic modifications (Srinivasan et al. 2015). Yet, it is increasingly being recognized that interventions at smaller scales have significant cumulative effects at the river basin scale, once they are adopted by millions of farmers or micro-watersheds. For example, farm bunds and check dams increase water availability upstream at the expense of flows into downstream reservoirs and drip irrigation projects may reduce recharge to groundwater. Groundwater abstracted from millions of private borewells, even while buffering users against rainfall variability, is also resulting in declining stream flows. Since studies rarely account for these smaller-scale processes, there has been a tendency in the climate resilience literature to blindly count these measures as climate adaptation, even if there are deleterious impacts at larger scales of these anthropogenic modifications.

An integrative framework must also include *all* drivers of changes at all scales in watersheds; such as groundwater pumping, watershed interventions, land use–land cover change, crop choice, and irrigation technology.

Bridging Scales from the Basin to Water User Remains a Challenge

Analysing the impact of climate change at the farm or household scale requires working across very disparate scales. There remain

sharp disciplinary disconnects. Climatologists estimate climate change patterns at fairly coarse regional scales. Hydrologists are adept at downscaling these patterns and applying them to basin-scale models to predict changes in stream flow, groundwater levels, or urban flooding. However, hydrologists seldom go beyond estimating average physical availability in a basin and lack the tools in translating basin-scale water availability into water access at the household or farm. On the other hand, social science research on adaptation and resilience in urban water provisioning has focused on households and/or communities. They tend to take the hydrological resource and engineering context as a given (Lele et al. 2018), while focusing on pre-existing vulnerability.

Much of the water used in urban or agricultural contexts is delivered to water users via piped or canal infrastructure. Inter-basin and intra-basin transfers, water transport and distribution systems, and effluent treatment plants play an important role in mediating between basin-level water availability and water availability to the user. These infrastructure projects may import large quantities of water from surrounding watersheds and significantly influence water availability, thus hedging against local rainfall. In fact, creating a diverse portfolio of water sources is often an explicit planning objective. Water supplied to cities or irrigation projects generates return flows that create new (albeit polluted) flows downstream. The legal and administrative framework and political process for surface water allocation across major sectors (for example, between agriculture, domestic, or industrial users, or between states) is crucial in determining who gets how much water when there is a shortage. For instance, the ‘domestic priority’ in the draft National Water Framework Law implies that farmers bear most of the cutbacks during droughts. A significant portion of irrigation and urban water is self-supplied via borewells. Groundwater regulations (indirectly through electricity pricing or directly through licensing) play a critical role in determining access to and use of groundwater resources. As a result, developing a complete understanding of water availability at the scale of a water user necessitates understanding both the physical layout of infrastructure projects as well as the rules—formal and informal—governing their operation under different conditions of water availability.

Implementing a Multiple-Concern, Multiple-Stressor, Multi-Level Approach Requires Integration of Human Dimensions, Stakeholder Participation, and Adaptive Management

In the context of climate and anthropogenic change, our experience derived from historical records does not tell us much about the frequency and intensity of extremes in the future. Taking into account the true complexity of water systems at different scales requires fundamental changes in how we approach water resources management, in at least three ways. First, it necessitates a move from techno-economic approaches to a complete integration of human dimensions.

Most models of water resources under climate change seem to hold land use and demand patterns static or use simple extrapolations. In reality, human demand for water is highly non-linear. It depends on land, labour, and commodity markets (Patil et al. 2019). The process of urbanization, industrialization, agricultural policy, among others, all significantly influence water demand and water availability in streams and aquifers. As the Indian economy grows, there are likely to be large-scale changes to demographic and employment patterns and water resources. This requires considering multiple, alternative socio-economic pathways, while also accounting for the path-dependent, sticky nature of infrastructure investments like large dams.

Second, taking full account of complexity requires greater stakeholder participation to understand what scenarios are possible. Once we accept that humans are going to constantly shape and reshape the waterscape over the next 100 years, the question is how do we anticipate these changes? By choosing which scenarios and processes get considered, water resources modellers have a disproportionately large effect on eventual social outcomes (Troy et al. 2015). Including stakeholders in the modelling process can ensure ownership of model results and the decisions that follow (Sivapalan and Blöschl 2015; Walker et al. 2012). While stakeholder participation in the framing and shaping of alternate futures is gaining popularity elsewhere in the world, in India it remains rare. Part of the problem is that facilitating formal participation requires investments in interdisciplinary training, better communication, and building legitimacy, which Indian water resources professionals are ill-equipped for.

Third, taking account of multiple concerns requires an adaptive and flexible approach to respond to new information under

changing conditions. Given the difficulty in anticipating the exact impacts of climate change, globally accepted principles of climate adaptation in the water sector generally entail low-regret decision making and a mix of hard (infrastructural) and soft path (decentralized, institutional, pricing, behavioural measures) scenario planning (IPCC 2014). Global discourses have also shifted towards adaptive water management (Pahl-Wostl 2007), advocating a shift from traditional prediction and control towards more flexibility and learning-by-doing. However, in India, the cycle of research, policy, to action remains fairly weak. In any case, most climate adaptation research remains in the theoretical domain with limited links to policy.

Mainstream Climate and Find Synergies in Existing Initiatives

Climate change adaptation in the water sector cannot occur without considering other changes that are also impacting water availability and demand. Existing agencies in the water sector have to respond to the exigencies of providing water to all, while addressing concerns over declining groundwater, disappearing streams, and so on. If climate change is to be mainstreamed into water sector planning, climate adaptation must become a part and parcel of existing sector policies and plans.

In India, the National Action Plan on Climate Change (NAPCC) prepared by the Government of India (GoI), in 2008, tasked the National Water Mission (NWM) with tackling the challenge of climate change in the water sector. The stated goal of NWM is to 'ensure integrated water resource management helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states'.¹ The NWM recommends a large number of water supply and demand management strategies, as well as institutional reform measures. In 2015, the NWM asked that state governments develop State Specific Action Plans on Water (SSAPs-Water), solely focused on state-level water management issues, including climate change adaptation (England 2018).

¹ See nwm.gov.in; accessed on 17 June 2019.

In practice, most states prepared ‘irrigation sector improvement plans’. Frustrated with the lack of a comprehensive, cross-sector approach to water, in April 2017, NWM began to shift its focus to the preparation of state water budgets, creating a template that would require states to track all sources and uses of water in the form of sub-basin-level ‘balance sheets’. Over the next several months, dozens of consultations were held and a detailed template was presented (GoI 2017). In October 2017, the then Ministry of Water Resources (MoWR) convened a workshop attended by national and state government officials, as well as non-government actors, at which state governments were advised to develop SSAPs-Water based on state-level context and requirements. Eleven states have committed to creating state water budgets as of April 2018.

Although the NWM is officially the agency tasked with climate adaptation in the water sector, water in India is a state subject; in any case, the vast majority of action needed to address climate change occurs at lower levels of government. Table 27.1 presents a mapping of normative concerns, as well as interventions to address each. In the subsequent sections, I will discuss how each of these can be implemented through actions at the local, state, and national level.

Extreme Events

Climate change is likely to alter the frequency and severity of flooding. Recent floods in Chennai and Mumbai have claimed dozens of lives. Subsequent research has suggested that the floods were not the result of intense rainfall alone, but also caused by poor or clogged drainage networks (Jamwal 2012). As low-lying areas and tanks have been filled to make multi-storey buildings and shopping malls, the natural water-holding capacity of cities has disappeared. The quantity of water falling on the city may or may not have changed, but the space for water to flow has declined, tremendously. Additionally, the very steps taken to tackle floods, such as embankments, have resulted in greater development and settlement in floodplains, worsening the impact of flooding. In the case of the 2009 Krishna basin flood, inadequate flood forecasting and improper management of reservoirs was a problem. Political

Table 27.1 Mapping of Water Concerns, Mechanisms, and Jurisdiction

Concern	Adaptation Mechanisms	Actors
Extreme Events		
<ul style="list-style-type: none"> Flooding 	<ul style="list-style-type: none"> Better flood forecasting, dissemination. Improvement of storm water infrastructure in cities. Surplus floodwater capture mechanisms. Room for the river plans in rural areas. 	Disaster-monitoring agencies; state water resources departments; and urban local bodies (ULBs).
Unsustainability of the Resource		
<ul style="list-style-type: none"> Declining inflows into reservoirs and groundwater recharge. Decreased dry season flows and springs. 	<ul style="list-style-type: none"> Better management of available water resources. Revise evaporation rate tables to account for higher temperatures. 	Central Water Commission; Central Ground Water Board; MoWR; state water resources departments; and forest departments.
Mismatch in Demand and Supply		
<ul style="list-style-type: none"> Agriculture: Changes in soil moisture, increased irrigation demand. Cities: Impacts on domestic, commercial, and industrial demand (outdoor versus indoor). 	<ul style="list-style-type: none"> Crop shifting by farmers to less water-intensive crops. Drip Irrigation. Climate-smart landscaping. Water efficiency in industry. Dietary shifts. 	Departments of agriculture and industry; urban water utilities; developers; industry; and citizens.
Water Quality and Environmental Health		
<ul style="list-style-type: none"> Dissolved oxygen (DO), algal blooms. Turbidity from extreme events. 	<ul style="list-style-type: none"> Building of sewage treatment plants (STPs). Change operations of STPs. 	Central and state pollution control boards; water utilities; and ULBs.

(cont'd)

Table 27.1 (cont'd)

Concern	Adaptation Mechanisms	Actors
<ul style="list-style-type: none">• Water-borne disease vectors: mosquitoes.• Mobilization of pollutants due to salinity, temperature, and flow regime changes.	<ul style="list-style-type: none">• Better management of drainage systems.• Enforcement of pollution laws.	
Water Conflicts		
<ul style="list-style-type: none">• Absence of mechanisms to deal with increased variability.	<ul style="list-style-type: none">• Flexibility in inter-state sharing and within state reservoir operations.• Market mechanisms: insurance schemes, short-term markets (farmers giving up shares to city in exchange for payment).	Inter-state tribunals; reservoir management boards; and state water resources departments.

Source: Compiled by author.

bias towards managing reservoirs to hold water back, rather than release water, and uncertainty over forecasts meant that no official was willing to take the risk of releasing water until the very last minute (Killada, Badiger, and Thomas 2012).

Flooding can only be proactively addressed through a participatory process of planning, enforcement of buffer zone regulations, and prevention of encroachment of storm drains and streams to create more ‘room for the river’, all of which would have to occur at the level of the urban local body or Panchayati Raj Institution. Once the encroachment has already occurred, the only option is the court system and increasingly, the National Green Tribunal. So, what might be required is an analysis to understand the extent to which these urban and rural local institutions comprehend and incorporate climate change considerations and if necessary, invest in communication strategies to improve them.

Unsustainability of the Resource

Climate change is expected to result in increasing variability, with more prolonged droughts and more dry days, interspersed with intense rainfall events. The only way to address increased variability, in the face of increasing demand for water, is to increase storage. The issue of storage, however, remains highly contested (Iyer 2013; Joy et al. 2008). On the one hand, the MoWR and state irrigation departments prefer centralized, top-down planning of large-scale infrastructure-based surface water management, including dams, reservoirs, and canal irrigation construction and management. On the other hand, the majority of non-government actors, including non-governmental organizations (NGOs), civil society, and industrial and farmer groups, have been advocating smaller-scale, decentralized water management practices, including rainwater harvesting, aquifer management, and small-scale surface water storage (Agarwal, Narain, and Khurana 2001). Indeed, as dam building has slowed down, in the last two decades, India's water policy has shifted to 'managed aquifer recharge' through watershed development, essentially using the massive capacity in India's underground aquifers to buffer climate variability (Shah 2008).

The problem is that increasing dependence on groundwater is depleting the buffering capacity of groundwater as shallow aquifers are drying up in parts of India (Shah 2010). Laws and administrative regulations, such as licensing, have been discussed and even piloted (Mukherji and Shah 2005); however, the logistical challenges of enforcing these on tens of millions of widely dispersed farmers (Planning Commission 2007) as well as overcoming political resistance to pricing groundwater remain formidable (Shah 2008).

The government has invested vast sums in mapping aquifers² and recharging groundwater in recent years. However, recent evidence suggests that recharge alone is unlikely to solve the problem. In closed basins, water resources are a zero-sum game; any water that recharges groundwater is water that does not flow downstream. The

² See <http://www.aquiferindia.org/>; accessed on 17 June 2019.

cumulative impacts of watershed development on reducing downstream flows has been documented by many studies (Glendenning et al. 2012). The solution is to manage groundwater recharge and abstraction simultaneously. While excellent case studies of ‘participatory groundwater management’ through *pani* panchayats exist in Maharashtra and Rajasthan, these solutions require high levels of social capital, trust, and leadership, and have not so far proved to be scalable. The GoI has recently announced the Atal Bhujal Yojana (formerly the National Groundwater Improvement Programme) to improve measurement, tracking, and management of groundwater on a massive scale.

Mismatch in Demand and Supply

Based on current projections, adaptation to uncertain resource availability is going to occur while demand for water is increasing. Water supply agencies in India are grappling with the challenge of how to match demand and supply. At present, each state, city, and gram panchayat is addressing this problem reactively, by lobbying for inter-basin transfers or drilling deeper. The fundamental problem is that the ministries that ‘control’ demand for water (such as power, agriculture, industries, and forests) are not accountable to the water resources ministry. There has to be a mechanism that ensures that annual water consumption (demand) by various sectors is within the limits of annual water availability (supply). Ensuring this remains a challenge because data on water use are largely missing. Even where such data exist, they are fragmented, inconsistent, and held by different agencies, who are reluctant to share.

In the absence of a single agency that coordinates water demand and holds the sectors accountable for excessive use—which is not politically feasible—some other approach that provides an integrated view is needed. The problem of climate change is that of allocating an increasingly uncertain pie, between multiple stakeholders. This has been recognized by the draft National Water Bill (MoWR 2016a) and the Model Groundwater Bill (MoWR 2016b), which have called for the creation of water security plans at the district and basin levels. A few states like Andhra Pradesh have been very proactive in collating data and presenting water budgets

statewide.³ The NWM's recent call for state water budgets is also based on the same idea.

The absence of data on how much water is being used is clearly not helping. Only time will tell if the data interventions being suggested will lead to more rational, fair allocation of water, or simply more contestation.

Water Quality and Environmental Health

Increased temperatures are likely to speed up bacterial activity in nutrient-rich rivers, resulting in decreases in dissolved oxygen and therefore aquatic life (Rehana and Mujumdar 2012). There is also a concern that declining flows will reduce the dilution capability of rivers. However, while climate change may exacerbate water quality, the main problem is the excessive pollution (mostly domestic sewage) itself. The solution, of course, is to ensure that sewage is treated and disposed safely. Thousands of crores have already been spent through the Ganga Mission alone in reducing sewage pollution in just one river, without making a significant dent in the problem. There is an ongoing debate in the water and sanitation sector on how to address the problem and whether on-site sanitation and septage management or conventional sewerage systems should be the goal. While climate change is marginal to these debates, there is one emerging area of overlap. Energy recovery through biogas from human excreta is increasing becoming feasible (Muralidharan 2017) and may represent a potential 'win-win' solution in the future.

Water Conflicts

Conflicts over water resources have been increasing in recent years, occasionally precipitating constitutional crises. In India, most inter-state rivers are governed by tribunals under the Inter-State Water Disputes Act, with inter-state river-sharing agreements instituted through negotiations over years, sometimes decades. Yet, contestations over inter-state rivers continue. The problem is that the tribunal agreements have typically focused on evolving a 'formula'

³ See apwrims.ap.gov.in; accessed on 17 June 2019.

for sharing. This entails determining how much of the 'basin yield' (measured at some specific reservoir) should be allocated to each riparian state. The agreements' focus is on timing and releases at specific reservoirs. The tribunals are poorly suited to addressing the threat of climate change and are, in general, not suited to adaptive approaches. They largely do not account for links between surface and groundwater and thus the fact that basin yield itself may change with increased groundwater abstraction. They also lack 'shortage-sharing' allocation mechanisms in dry years and do not account for future changes to climate.

This chapter makes three core arguments. First, the future of water resources is about 'everything change'; climate is only one of the many stressors and resilience is only one of the many normative concerns the sector must grapple with. Second, climate and socio-economic futures are inextricably interlinked as they affect supply and demand, respectively, and they are constantly evolving. This requires a participatory, adaptive management approach. Third, climate change adaptation cannot occur in isolation. It must be mainstreamed into planning processes at each scale of government and this necessarily involves coordination across agencies.

This is a daunting challenge. Yet, the prominence of climate change in national and international discourses suggests that even if climate change is not the biggest current threat to water resources in India, it offers an opportunity for transformative change in the water sector. Where governance in the water sector has remained highly fragmented with between 20 and 30 departments addressing some part of the problem, climate change offers the opportunity to create agencies that can drive inter-agency coordination. Perhaps the biggest hope lies here.

References

- Agarwal, Anil, Sunita Narain, and Indira Khurana. 2001. *Making Water Everybody's Business: Practice and Policy of Water Harvesting*. New Delhi: Centre for Science and Environment.

- Amarasinghe, Upali, Tushaar Shah, Hugh Turrall, and B.K. Anand. 2007. 'India's Water Future to 2025–2050: Business-as-Usual Scenario and Deviations', *Research Report 123*, International Water Management Institute, Colombo, Sri Lanka.
- Batchelor, C.H., M.S. Rama Mohan Rao, and S. Manohar Rao. 2003. 'Watershed Development: A Solution to Water Shortages in Semi-Arid India or Part of the Problem', *Land Use and Water Resources Research*, 3(1): 1–10.
- Bates, B.C., Z.W. Kundzewicz, S. Wu, and J.P. Palutikof. 2008. 'Climate Change and Water', Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat: Geneva.
- Dieter, Cheryl A. and Molly A. Maupin. 2017. 'Public Supply and Domestic Water Use in the United States, 2015', US Geological Survey, Reston, Virginia. Available at <https://pubs.usgs.gov/of/2017/1131/ofr20171131.pdf>; accessed on 17 June 2019.
- England, Matthew I. 2018. 'India's Water Policy Response to Climate Change', *Water International*, 43(4): 512–30.
- Ghosh, S., D. Raje, and P.P. Mujumdar. 2010. 'Mahanadi Streamflow: Climate Change Impact Assessment and Adaptive Strategies', *Current Science*, 98(8): 1084–91.
- Glendenning, C.J., F.F. Van Ogtrop, A.K. Mishra, and R.W. Vervoort. 2012. 'Balancing Watershed and Local Scale Impacts of Rain Water Harvesting in India—A Review', *Agricultural Water Management*, 107: 1–13. Available at doi:10.1016/j.agwat.2012.01.011.
- Gosain, A.K., S. Rao, and D. Basuray. 2006. 'Climate Change Impact Assessment on Hydrology of Indian River Basins', *Current Science*, 90(3): 346–53.
- Government of India (GoI). 2017. 'SSAP Model Templates'. Available at <http://www.nationalwatermission.gov.in/?q=ssap-water-model-template-full-copy>; accessed on 17 June 2019
- Grafton, R. Quentin, Jamie Pittock, Richard Davis, John Williams, Guobin Fu, Michele Warburton, Bradley Udall, et al. 2013. 'Global Insights into Water Resources, Climate Change and Governance', *Nature Climate Change*, 3(4): 315–21. Available at doi:10.1038/NCLIMATE1746.
- Guhathakurta, P., O.P. Sreejith, and P.A. Menon. 2011. 'Impact of Climate Change on Extreme Rainfall Events and Flood Risk in India', *Journal of Earth System Science*, 120(3): 359.
- Indian Institute for Human Settlements (IIHS). 2014. 'Sustaining Policy Momentum: Urban Water Supply & Sanitation in India'. Bengaluru. Available at <http://iihs.co.in/knowledge-gateway/sustaining-policy-momentum-urban-water-supply-sanitation-in-india/>; accessed on 17 June 2019.

- Intergovernmental Panel on Climate Change (IPCC). 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, Vol. 1. Cambridge and New York: Cambridge University Press.
- Iyer, Ramaswamy R. 2013. 'The Story of a Troubled Relationship', *Water Alternatives*, 6(2): 168–76.
- Jain, Sharad K. and Vijay Kumar. 2012. 'Trend Analysis of Rainfall and Temperature Data for India', *Current Science*, 102(1): 37–49.
- Jamwal, Nidhi. 2012. 'Mumbai under Floods: A Natural Disaster or Manifestation of an Underlying Conflict in Mumbai City's Skewed Urban Planning?', in Eklavya Prasad, K.J. Joy, Suhas Paranjape, Shruti Vispute (eds), *Agony of Floods: Flood Induced Water Conflicts in India*, pp. 90–100. Pune: Forum for Policy Dialogue on Water Conflicts in India.
- Jaswal, A.K., P.C.S. Rao, and V. Singh. 2015. 'Climatology and Trends of Summer High Temperature Days in India during 1969–2013', *Journal of Earth System Science*, 124(1): 1–15.
- Jones, P.D., M. New, D.E. Parker, S. Martin, and I.G. Rigor. 1999. 'Surface Air Temperature and Its Changes over the Past 150 Years', *Reviews of Geophysics*, 37(2): 173–99.
- Joy, K.J., B. Gujja, S. Paranjape, V. Goud, and S. Vispute. 2008. *Water Conflicts in India: A Million Revolts in the Making*. New Delhi: Routledge.
- Killada, Narendra V., Shrinivas Badiger, and Bejoy K. Thomas. 2012. 'Flood in Krishna Basin', *Agony of Floods: Flood Induced Water Conflicts in India*, pp. 101–12. Pune: Forum for Policy Dialogue on Water Conflicts in India.
- Krishnamurthy, Chandra Kiran B., Upmanu Lall, and Hyun-Han Kwon. 2009. 'Changing Frequency and Intensity of Rainfall Extremes over India from 1951 to 2003', *Journal of Climate*, 22(18): 4737–46.
- Kumar, Praveen. 2011. 'Typology of Hydrologic Predictability', *Water Resources Research*, 47(4). Availbale at doi:10.1029/2010WR009769.
- Lele, Sharachchandra, Veena Srinivasan, Bejoy K. Thomas, and Priyanka Jamwal. 2018. 'Adapting to Climate Change in Rapidly Urbanizing River Basins: Insights from a Multiple-Concerns, Multiple-stressors, and Multi-level Approach', *Water International*, 43(2): 281–304.
- Milly, Paul C.D., Julio Betancourt, Malin Falkenmark, Robert M. Hirsch, Zbigniew W. Kundzewicz, Dennis P. Lettenmaier, and Ronald J. Stouffer. 2008. 'Stationarity is Dead: Whither Water Management?', *Science*, 319(5863): 573–4.
- Ministry of Water Resources (MoWR). 2016a. 'Draft National Water Framework Bill'. Available at <http://mowr.gov.in/policies-guideline/policies/draft-national-water-framework-bill-2016>; accessed on 17 June 2019.

- _____. 2016b. 'Model Bill for Conservation, Protection, Regulation and Management of Ground Water'. Available at http://mowr.gov.in/sites/default/files/Model_Bill_Groundwater_May_2016_0.pdf
- Mukherji, Aditi and Tushaar Shah. 2005. 'Groundwater Socio-ecology and Governance: A Review of Institutions and Policies in Selected Countries', *Hydrogeology Journal*, 13(1): 328–45.
- Muralidharan, Arunaachalam. 2017. 'Feasibility, Health and Economic Impact of Generating Biogas from Human Excreta for the State of Tamil Nadu, India', *Renewable and Sustainable Energy Reviews*, 69: 59–64.
- Narsimlu, Boini, Ashvin K. Gosain, and Baghu R. Chahar. 2013. 'Assessment of Future Climate Change Impacts on Water Resources of Upper Sind River Basin, India Using SWAT Model', *Water Resources Management*, 27(10): 3647–62.
- Pahl-Wostl, Claudia. 2007. 'Transitions towards Adaptive Management of Water Facing Climate and Global Change', *Water Resources Management*, 21(1): 49–62.
- Patel, Dhruvesh P. and Naresh Nandhakumar. 2016. 'Runoff Potential Estimation of Anjana Khadi Watershed Using SWAT Model in the Part of Lower Tapi Basin, West India', *Sustainable Water Resources Management*, 2(1): 103–18.
- Patil, Vikram, Bejoy K. Thomas, Sharachchandra Lele, Meghana Eswar, and Veena Srinivasan. 2019. 'Adapting or Chasing Water? Crop Choice and Farmers' Responses to Water Stress in Peri-Urban Bangalore, India', *Irrigation and Drainage*, 68(2): 140–51.
- Paul, S., M.A. Hasan, A.K.M.S. Islam, and M.M. Rahman. 2015. 'Assessment of Change in Future Water Resources of Brahmaputra Basin Applying SWAT Model Using Multi-Member Ensemble Climate Data', in *Proceedings of the 5th International Conference on Water and Flood Management (ICWFM 2015)*, 6–8 March 2015, pp. 547–56. Dhaka: Citeseer.
- Planning Commission. 2007. *Groundwater Management and Ownership: Report of the Expert Group*. New Delhi: Planning Commission, GoI.
- Rehana, S. and P.P. Mujumdar. 2012. 'Climate Change Induced Risk in Water Quality Control Problems', *Journal of Hydrology*, 444: 63–77.
- Saha, A., S. Ghosh, A.S. Sahana, and E.P. Rao. 2014. 'Failure of CMIP5 Climate Models in Simulating Post-1950 Decreasing Trend of Indian Monsoon', *Geophysical Research Letters*, 41(20): 7323–30.
- Shah, Tushaar. 2008. 'India's Master Plan for Groundwater Recharge: An Assessment and Some Suggestions for Revision', *Economic & Political Weekly*, 43(51): 41–9.
- _____. 2010. *Taming the Anarchy: Groundwater Governance in South Asia*. New York: Routledge.

- Sivapalan, Murugesu and Günter Blöschl. 2015. 'Time Scale Interactions and the Coevolution of Humans and Water', *Water Resources Research*. Available at doi:10.1002/2015WR017896.
- Srinivasan, V., M. Sanderson, M. Garcia, M. Konar, G. Blöschl, and M. Sivapalan. 2017. 'Prediction in a Socio-hydrological World', *Hydrological Sciences Journal*, 62(3): 338–45.
- Srinivasan, Veena, Bejoy K. Thomas, Priyanka Jamwal, and Sharachchandra Lele. 2013. 'Climate Vulnerability and Adaptation of Water Provisioning in Developing Countries: Approaches to Disciplinary and Research–Practice Integration', *Current Opinion in Environmental Sustainability*, 5(3–4): 378–83. Available at doi:10.1016/j.cosust.2013.07.011.
- Srinivasan, Veena, Sally Thompson, Karthik Madhyastha, Gopal Penny, Kirubaharan Jeremiah, and Sharachchandra Lele. 2015. 'Why is the Arkavathy River Drying? A Multiple Hypothesis Approach in a Data Scarce Region', *Hydrology and Earth System Science*, 19(4): 1905–17. Available at doi:10.5194/hess-19-1905-2015.
- Troy, T.J., M. Konar, V. Srinivasan, and S. Thompson. 2015. 'Moving Sociohydrology Forward: A Synthesis across Studies', *Hydrology and Earth System Sciences*, 19: 3667–79. Available at doi:10.5194/hess-19-3667-2015.
- Vorosmarty, C.J. 2000. 'Global Water Resources: Vulnerability from Climate Change and Population Growth', *Science*, 289(5477): 284–8. Available at doi:10.1126/science.289.5477.284.
- Walker, Brian H., Stephen R. Carpenter, Johan Rockstrom, Anne Sophie Crépin, and Garry D. Peterson. 2012. 'Drivers, Slow Variables, Fast Variables, Shocks, and Resilience', *Ecology and Society*, 17(3). Available at doi:10.5751/ES-05063-170330.
- Xu, Jianchu, R. Edward Grumbine, Arun Shrestha, Mats Eriksson, Xuefei Yang, Y.U.N. Wang, and Andreas Wilkes. 2009. 'The Melting Himalayas: Cascading Effects of Climate Change on Water, Biodiversity, and Livelihoods', *Conservation Biology*, 23(3): 520–30.

Mainstreaming Climate Change Adaptation

Agriculture

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Climate change is likely to have large adverse effects on several climate-sensitive sectors, such as agriculture, particularly in developing countries. The scale of impacts is likely to be beyond the ability of climate finance to ameliorate and in any case, the prospects for large quantities of finance appear limited particularly for large, rapidly emerging economies like India. Consequently, the best available option that developing countries may have is to 'mainstream' climate change adaptation policy into their existing and future development policy and planning, that is, improving development prospects, while making the economy and its poorer sections of population climate resilient. Socio-economic development has the potential to reduce the existing development deficit, and in turn adaptation deficit, both of which could in turn augment the capacity of the country to adapt to climate change and natural disasters, exploiting synergies between development and climate resilience. Mainstreaming will also

enable a more integrated and less of a piecemeal approach towards achieving development objectives.

Against this background, this chapter provides an overview of issues surrounding the mainstreaming of climate change adaptation in the agriculture sector. The chapter is structured as follows. The next section takes stock of climate change impact studies to understand knowledge gaps and research priorities. The subsequent section discusses the status of adaptation research focusing on triggers of adaptation and adaptation strategies. The following section deliberates on approaches for mainstreaming climate change adaptation policies and associated institutional requirements.

Climate Change Impacts on Indian Agriculture

Available evidence suggests significant welfare implications of climate change impacts on agriculture. Agronomic studies suggest that for every 1°C increase in temperature during the growing season, the wheat production in India could reduce by 4–5 million tons (Swaminathan and Kesavan 2012); and rice yields may decline by about 6 per cent (Saseendran et al. 2000). Studies analysing the changing climate trends indicate that minimum temperature during the kharif season is increasing at 0.19°C every decade, and that such a rise will have an adverse impact on paddy yields in about half of the total cultivated area in India (Bapuji Rao et al. 2014). Further, warming during the rabi season has serious implications for the production of crops like wheat, mustard, and chickpea in the Indo-Gangetic plains. With the growing contribution of rabi season production in the total food grain production in recent years, the adverse impact of climate on rabi production is of equal significance to that on kharif production. Besides direct effects on crops, climate change is likely to impact natural resources like soil and water (National Academy of Agricultural Sciences [NAAS] 2013). Increased rainfall intensity in some regions could cause more soil erosion, leading to land degradation. Increased temperatures will also increase crop water requirement. Studies indicate that irrigation requirement in arid and semi-arid regions could increase by 10 per cent for every 1°C rise in temperature (Venkateswarlu et al. 2011). In addition to the temperature and rainfall effects, studies show that climate change impacts will have significant distributional effects,

with poorer farmers getting more adversely affected than better-off farmers (Gupta, Sen, and Srinivasan 2014), and that climate change will influence crop productivity along with several other stresses such as aerosol pollution (Auffhammer, Ramanathan, and Vincent 2006).

The climate change impacts on agriculture vary across studies based on the methodologies followed, crops considered, future climate change scenarios included, extent of adaptation considered, and geographic regions covered. The aggregate impacts of climate change on yields of rice and wheat crops are summarized here to provide a broad idea about the direction and extent of impacts. The irrigated rice yield is expected to reduce by about 4 per cent in 2020, 7 per cent in 2050, and 10 per cent in 2080 (Mall, Gupta, and Sonkar 2017; Naresh Kumar et al. 2013). Further these studies report that rain-fed rice yields are expected to reduce by about 6 per cent in 2020, and reduce only marginally in 2050 and 2080. Wheat yields are projected to reduce by 6 per cent and 15 per cent by 2050 and 2080, respectively, if sown on time and by 28 per cent and 35 per cent, respectively, if sown late (Naresh Kumar et al. 2014). Given that climate has already changed to some extent, few studies provided hind-casting estimates of the climate change on rice and wheat yields. The average rice yield would have been 8.4 per cent higher had the pre-1960 climatic conditions prevailed over the period 1969–2007, implying average annual production loss of 4.4 million tonnes per year (Pattanayak and Kumar 2014). Similarly, Gupta, Somanathan, and Dey (2016) estimate that the wheat yields in India were lowered by about 5.2 per cent due to climate change observed over the period 1981–2009.

While agriculture is one of the more widely analysed sectors with regard to climate change impacts, there is still considerable debate in the literature on the appropriate methodology to examine these impacts. Summarizing the debate, Blanc and Reilly (2017: 255) observe that ‘unfortunately, even if climate change could be predicted with certainty, we are still far from conclusively determining its effects on agriculture, either globally or for specific farming regions’. Some of the research priorities in Indian context are outlined later in the chapter.

Methodological Issues

Climate change impacts have traditionally been assessed in terms of physical impacts (such as changes in yield and acreage sown),

or the associated economic impacts. Over the years, there has been steady increase in both categories of studies, but significantly larger increase in physical impact studies than the economic impact studies. Further, there has been proliferation of ‘statistical’ method as a preferred method of impact estimation, both for physical as well as economic impact assessment.

Statistical models relying on data from different locations—cross-sectional data—have been in use from the mid-1990s in the field of climate change impact literature. Referring to the cross-sectional statistical model-based approach as the Ricardian approach, Mendelsohn, Nordhaus, and Shaw (1994), in their study of climate change impacts on the United States (US) agriculture, compare farms across different places—each of which is adapted to local climatic conditions—to empirically estimate the equilibrium climate response of farms to climate. One of the main advantages of the Ricardian approach is that it takes into account the full range of farm-level adaptation possibilities. However, in practice, it may be difficult to identify and include *all* the control variables that would affect agricultural variables (say, farm profitability) in the long term, in the regression models. The omission of some of these control variables is a misspecification of the regression model and hence would bias the quantitative estimates of the net impact of climate variable on the agricultural variable.

One of the approaches used to address this limitation is to increase the information base by including the data on the same cross-section units over several periods of time (referred to as a panel data set). This additional data enhances the scope to account for location-specific and time-specific heterogeneities that are unobserved by bringing in additional coefficients in the regression model. Such a model specification is called panel fixed effects model, as the omitted variables are absorbed as coefficients fixed over either time or over cross-section (see Dell, Jones, and Olken 2014; Deschênes and Greenstone 2007). In these models, weather variables are used instead of climate variables as the time-invariant nature of the climate variable clashes with the location-specific fixed effects coefficients. Hence, the panel fixed effects models estimate impacts due to weather shocks, and not necessarily impacts due to climate change.

In line with the global trends, there has been increasing use of statistical models in the context of Indian agriculture too, both

for impact assessments based on physical outcomes, such as yield (see, for example, Auffhammer et al. 2012; BIRTHAL et al. 2014; Gupta, Sen, and Srinivasan 2014; Krishnamurthy 2012; Lobell, Schlenker, and Costa-Roberts 2011; Pattanayak and Kumar 2014; and Saravanakumar 2015), and for impact assessments based on economic outcomes, such as net revenue (see, for example, Kar and Das 2015 and Kumar 2011). While these studies may be accurately assessing the impact of weather shocks, attributing the results to climate change could be misleading for several reasons, as highlighted by Dell, Jones, and Olken (2014). Even though the panel models correctly identify the causal effect of weather shocks on economic outcomes, they may not provide accurate insight on the likely effects of future climate change. The effects of weather shocks (as estimated by the panel fixed effects models) will be larger than the (true) effects of climate change if adaptation plays a dominant role. On the other hand, the effects of weather shocks will be smaller than the (true) effects of climate change if variation in temperature and precipitation become more intense.

Further, there is considerable uncertainty with regard to choice of climate variables in the impact literature. For example, in a study on the rice crop cultivation in India, Pattanayak and Kumar (2017) show that magnitude and distribution of simulated impacts of historical changes in climate on rice yield are significantly different when estimated based on a model that includes both minimum and maximum temperature (see Panel B in Figure 28.1 [between pages 326 and 327]) when compared to a model that includes only minimum temperature (Panel A in Figure 28.1). As it could be seen, the daytime temperature effects outweigh the positive effects observed in Panel A. Overall, there is still considerable scope for research on appropriate model specification in climate impact research.

While much research still needs to be done on assessing the aggregate impacts of climate change across sectors and at the macro level, there is significant evidence in the literature to suggest that aggregate impacts could be misleading if used for adaptation purposes. Pattanayak and Kumar (2017), for example, show in the context of rice crop that regional impacts are overestimated when simulated using an all-India yield response function, as against those based on region-specific yield response function that incorporates

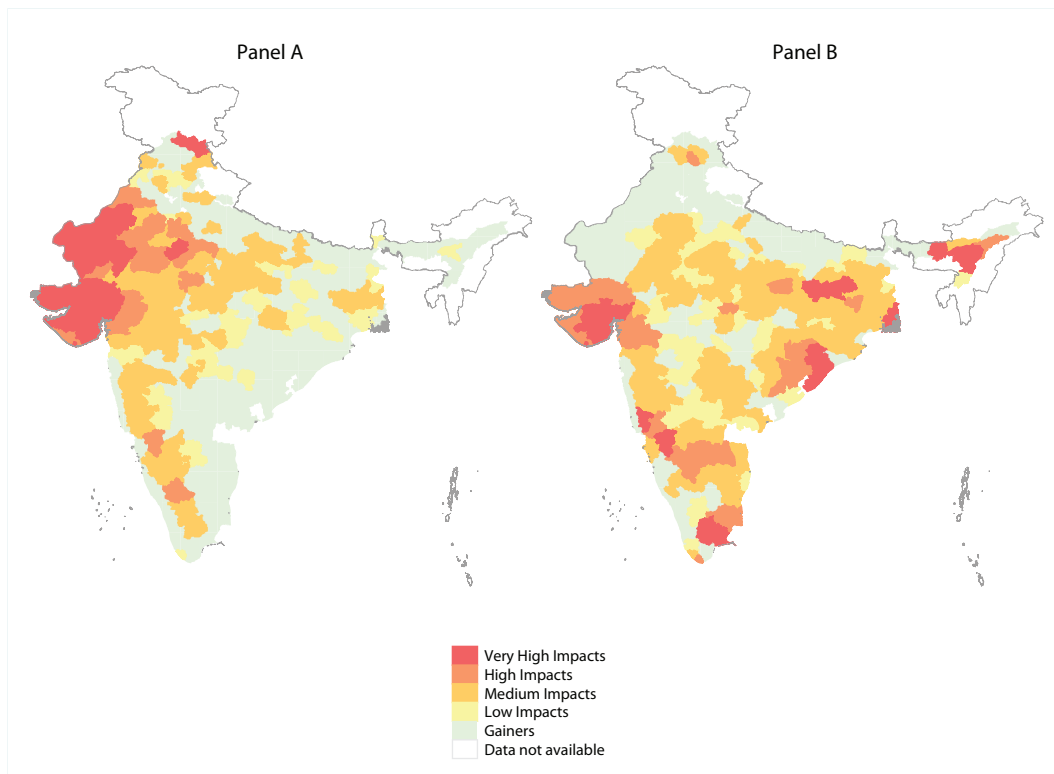


Figure 28.1 Climate Sensitivity of Rice Crop—Which Variables Matter?

Note: This map does not represent the authentic international boundaries of India. It is not to scale and is provided for illustrative purposes only.

Source: Adapted from Pattanayak and Kumar (2017).

the features of regional crop calendar and regional crop management practices. Also, for effective policymaking, there is urgent need to improve our understanding about the impact distribution across geographic regions as well as various socio-economic groups (see Gupta, Ramaswami, and Somanathan 2017; Jacoby, Rabassa, and Skoufias 2014; Kar and Das 2015).

Vulnerability to Climate Change

Several studies have focused on assessing the vulnerability of climate sensitive sectors and geographical regions in India to climate change using the conceptualization promoted by the *Third Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC). Accordingly, vulnerability is defined as a function of exposure, sensitivity, and adaptive capacity. Since it is difficult to accurately measure these three attributes of vulnerability, most studies have adopted an indicator-based approach to combine various aspects and express vulnerability as an aggregate index. Thus, O'Brien et al. (2004) used district-level data on several indicators to assess the exposure, sensitivity, and adaptive capacity components of vulnerability. The study considered vulnerability to globalization in tandem with climate change to define what they term as 'double exposure'. While this, and other similar studies, does not exclusively focus on agriculture, it remains one of the dominant factors characterizing the vulnerability of a region. In a recent study, Rama Rao et al. (2016) have assessed the vulnerability of Indian agriculture to climate change across 572 districts. The study identifies that most of the districts with very high and high vulnerability are those from the states of Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh, Karnataka, and Maharashtra. By and large, the vulnerability literature highlights the role of multiple stressors and the importance of improving the adaptive capacity of vulnerable entities/regions in general, not specific to climate change alone.

Adaptation Research

Research on adaptation in the climate change context has evolved over the past two decades in line with the shift in the global climate

change policy. Klein et al. (2017) provide a comprehensive summary of the evolution of climate change adaptation research, juxtaposing it with the evolving climate change policy context. In particular, they identify four generations of adaptation research:

1. First generation: potential impacts of climate change, along with costs and benefits of adaptation.
2. Second generation: the role of social factors in exacerbating vulnerability to climate change, including the role of adaptive capacity and factors that could improve it.
3. Third generation: distributional and financing issues as well as the policies/institutions to support adaptation activities.
4. Fourth generation: how adaptation actually works at the ground level, with a focus on implementation and approaches to 'main-stream' climate change adaptation.

One way to understand the evolution of these different generations of adaptation research could be to view them with reference to the temporal and spatial scales that these studies deal with. Figure 28.2 provides a visual representation of the progress in adaptation research. While the first-generation studies focused on

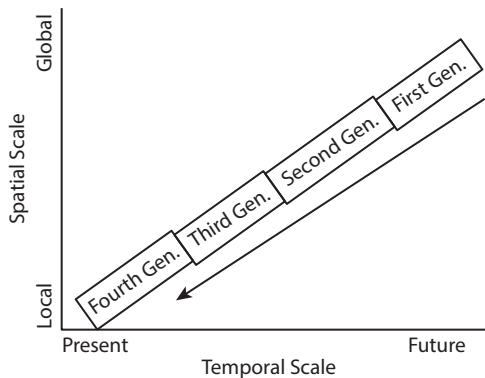


Figure 28.2 Schematic Representation of Evolution of Climate Change Adaptation Research

Source: Prepared by author.

adaptation needs at aggregate geographical regions and in distant future, the fourth-generation studies are more concerned about adaptation at specific locations, and in response to the weather/climate shocks that are experienced currently.

In the Indian context, there have been varying degrees of focus on these strands of adaptation research. While there were only a few studies that systematically analysed the role of adaptation in climate change impact studies (that is, the first generation of adaptation research), a large number of studies focused on vulnerability assessment. Many of the vulnerability assessments, however, tend to capture generic vulnerability rather than vulnerability in the climate change context. Studies that could be classified as those in the third generation of adaptation research are still evolving. A major challenge concerning these studies remains in establishing a robust climate change connection. Notwithstanding such concerns, there has been a proliferation of studies in India that broadly fall in the category of fourth-generation adaptation research studies. In their pursuit to implement the climate change action plans, many state governments are currently implementing several adaptation activities across India. However, the climate change context is often unclear in these activities and as a result, many such activities could be seen as activities implemented to bridge the existing 'development deficit'.

Adaptation Costs and Benefits

As discussed in the previous section, climate change will have significant adverse impacts on agriculture, especially in developing countries like India. Given the large proportion of the population dependent on agriculture—directly and indirectly—adverse effects on agriculture could easily translate into an escalation of poverty. Some studies have tried to assess the costs of adaptation in the context of agriculture sector. In line with the adaptation continuum argument, adaptation costs can be expressed as investments needed to maintain certain welfare objectives (for example, maintaining a certain level of calorie per capita). The adaptation costs in such scenarios can be assessed by first estimating the productivity growth needed to meet, say, the calorie availability target

(welfare objective), and then estimating the investment expenditure needed in, say, research and development, rural infrastructure, and so on, to generate the required productivity growth (see, for example, Nelson et al. 2009). Using such an approach, additional annual investments needed to counteract climate change impact on nutrition in India are estimated as US\$3.3 billion,¹ with bulk of investments going to rural infrastructure (for example, roads) and irrigation. Another study, Bhadwal, Ghosh, and Martin-Ortega (2011), on the other hand, provided estimates of adaptation costs based on a bottom-up approach. The annual adaptation costs in agriculture (in India) are estimated as US\$1.0–1.5 billion by 2020 and US\$1.8–2.2 billion by 2050 towards autonomous adaptation. The planned adaptation will be over and above the autonomous adaptation.

With regard to benefits of adaptation, the bulk of the available evidence draws from the studies that model adaptation as a transition from one equilibrium to another in response to climate change shock. In the context of agriculture, the Ricardian approach, discussed earlier, follows such strategy (see Kumar and Parikh 2001; Sanghi and Mendelsohn 2008). However, these equilibrium-based models assume instantaneous adaptation and ignore adjustment costs, thereby overestimating the benefits from adaptation (Hanemann 2000).

Adaptation Strategies

Zilberman, Zhao, and Heiman (2012) highlight several strategies for the implementation of adaptation. These include innovation, adoption (of technology), risk management, and migration. Historically changing weather conditions as well as growing food demand have led to a variety of innovations that facilitated the movement of agricultural practices to regions that hitherto were not cultivated due to non-favourable climatic conditions. The

¹ It may be noted that comparable adaptation costs in South Asia and sub-Saharan Africa were estimated to range from US\$7.1 to US\$7.3 billion under different climate change scenarios. The recent assessments by the Government of India, on the other hand, are much higher.

literature has identified a number of factors contributing to innovations, including public research, conducive institutional structure, and policy environment. Existing regulations (on, say, land use) may, however, hamper development of technologies and crops that enable adaptation to climate change.

The literature on adoption focuses on decisions regarding new technologies. Studies focusing on autonomous adaptation, in contrast, focus on adoption of existing technologies—for instance, the Ricardian approach used for assessing climate change impacts on agriculture assumes that farmers will adapt to climate change along the current technology envelope. However, in case of proactive adaptation, there will be sufficient response time to the changes, and hence the emphasis will be on adoption of new technologies. Independent of whether the choice is between the existing and the new technologies, it is relevant to take stock of uptake of technologies by the farmers in India. Palanisami et al. (2015), based on the analysis of four decades of research on water management in India, observe that farm-level adoption rate is only 22 per cent of the technologies developed by the research centres. Since more than three-fourths of the practices followed by the farmers are still based on local and traditional wisdom, it is important to validate the traditional technologies. It is also important to understand the reasons behind non-adoption of new technologies and strengthen the outreach activities of the research centres.

There has been extensive literature on risk management through insurance. However, implementation of insurance in the agriculture sector has always been challenging, especially in countries like India. Cole, Gine, and Vickery (2014) use randomized control trial involving a sample of Indian farmers from two drought-prone districts, namely, Mahbubnagar and Anantapur, to study how rainfall insurance affects the real production and investment decisions of farmers, such as crop choices and usage of agricultural inputs. They find that the provision of insurance causes substitutions in agricultural investments towards cash crops that are more rainfall sensitive. This shift in behaviour is concentrated among more educated farmers. Similarly, Mobarak and Rosenzweig (2012) find evidence from India that insured households were more likely to plant higher-yield but less drought-resistant varieties of rice. Due to interdependency

with other adaptation activities, insurance policies often need to be designed in congruence with other strategies to overcome moral hazard problems.

Migration is often considered as an effective adaptation strategy. However, one has to keep in mind that migration from agriculture occurs as a natural result of development. Further, in the developing country context, there is often short and long-duration migration. Viswanathan and Kumar (2015) analyse census data to show that while the weather-induced agricultural distress could lead to migration from rural to urban areas in India, the magnitude of the response is relatively small in India compared to those reported in the literature for developed countries. Specifically, the study argues that 1 per cent decline in rice yield leads to nearly 2 per cent increase in the rate of out-migration from a state in India. Similarly, a 1 per cent decline in wheat yield leads to a 1 per cent increase in out-migration. In another study, Kumar and Viswanathan (2013) highlight the differences in the influence of weather variability on temporary migrants as well as permanent migrants using National Sample Survey data for India. The study results show that the migrants involved in agriculture-related activities are usually temporary migrants for whom weather variability is a major determinant of migration decision. Further, it is argued that rainfall variability plays a relatively less important role in the context of permanent migration decisions. If one views migration as adoption of a new location, then one may expect to see synergy between adoption literature and migration literature. Future research in this context could also include analysis of migration decisions in the presence of regulatory and land-use constraints.

Mainstreaming Adaptation

The adverse effects of climate change are manifested through changes in development outcomes (for example, through increased population that is poor or malnourished). However, development outcomes are affected by a host of factors or stressors that may not be directly connected with climate. Thus, climate is only one amongst several factors determining the development outcome of a society. In reality,

at a more local scale, there could be multiple stressors that determine the aggregate vulnerability of a system.

Assessing the society's vulnerability to climate change in isolation, therefore, is not warranted. Such assessment would undermine the role of other stressors in exerting direct or indirect (through interaction with climate) influence on societal welfare. The foremost consequence of this is the significant underestimation of the aggregate vulnerability to climate change. Further, this would lead to inappropriate choice of policies and measures. Moreover, while involving additional costs, the overall effectiveness of adaptation could be limited given the specific nature of the adaptation measures. The choice of inappropriate policy could prove to be significantly costly, especially for the developing countries, where climate change impacts will be more severe and the basic resources to tackle the problem are limited.

Similar arguments can also be made with regard to risks imposed by natural disasters, such as droughts, cyclones, and floods, and sudden onset events, like flash floods and hailstorms. While event-specific response strategies cannot be ruled out, it could be prudent to enhance the resilience of the society to absorb the adverse impacts caused by such natural disasters. Further, there are close linkages between the changes in climate and the frequency and magnitude of climate-induced natural disasters. This has brought forward the notion of climate risk management (CRM) (see Mechler and Schinko 2016, for more details). It is argued that the CRM framework could be particularly useful in complex situations characterized by large potential consequences, persistent uncertainties, long time frames, potential for learning, and multiple climatic and non-climatic influences changing over time.

Mainstreaming—Approaches

Based on various country experiences with regard to mainstreaming climate resilience into development planning, Pervin et al. (2013) identify three broad approaches: climate-proofing, climate-first, and development-first. The climate-proofing approach aims to protect development interventions that have been planned in isolation

without taking climate change into context. It simply aims at making the development intervention resilient to climate variability and climate change. Climate proofing of watershed development initiatives of National Bank for Agriculture and Rural Development (NABARD) in the states of Tamil Nadu and Rajasthan is an example of mainstreaming of climate adaptation in the agriculture sector. Climate-first approach aims to address incremental change in existing climate-related risks. It typically involves designing pilot intervention strategies that are climate resilient and (if found effective) subsequently scaling up to sectoral and/or national plans. Examples include climate-smart agriculture practices and climate-smart village approach (Aggarwal et al. 2018). Emerging evidence suggests that development deficit often constrains the scaling-up of the climate-first interventions. Further, lack of synergy between strategies promoted under climate-smart agriculture and pricing policies could lead to unsustainability of the interventions (Kumar 2018). The third mainstreaming approach, namely, development-first approach, keeps climate resilience as an integral part of the development planning process from the very beginning. There is relatively less evidence of mainstreaming on these lines in India, as it requires significant changes in the institutional structures.

It is also relevant to note here the emerging literature on adaptation pathways. In contrast to conceptualizing adaptation as discrete actions made in response to specific changes (in, say, climate), this strand of literature characterizes adaptations as dynamic and continually unfolding pathways. Such a conceptualization of adaptation facilitates careful understanding of the synergy and contradiction between individual, household, and community-scale adaptation, and the higher-scale adaptation decision process (Burnham, Rasmussen, and Ma 2018). In the pursuit towards mainstream adaptation, such understanding is essential to avoid creation of new vulnerabilities while addressing climate change vulnerability. The adaptation pathways research would also establish the required connection between different generations of adaptation research discussed in the previous section.

Under the National Adaptation Fund, NABARD has sanctioned several projects worth over Rs 660 crore (Rs 6.6 billion) across different states of India. Close to 60 per cent of these interventions can be classified as climate-proofing projects, with the rest constituting the climate-first type interventions. Yet, most of these projects could also be seen as sustainable development interventions. While most climate change adaptation interventions will have development co-benefits, caution must be exercised against using climate change adaptation to achieve development goals. The wide range of budgetary requirements given by different State Action Plans on Climate Change (SAPCCs) for the agricultural sector reflect the inherent difficulty in disentangling development and climate change adaptation, as well as the convenience that scope for climate change funding provides for meeting legitimate development goals. The budgetary requirement for adaptation in agricultural sector in states like Uttar Pradesh and Uttarakhand was as low as Rs 100 crores (1 billion), while Tamil Nadu estimated its requirements as above Rs 23,000 crores (Rs 230 billion) (Kumar 2018).

Effective mainstreaming of adaptation depends critically on how adaptive the existing institutional structure is towards integrating climate change concerns. In India, SAPCC and State Disaster Management Plan (SDMP) are the formal institutional platforms at state level to mainstream climate risk and disaster risk into development planning, respectively. For effectively addressing the climate risk and the disaster risk, it is important to synergize different plans into development planning (Bahadur, Lovell, and Pichon 2016; Dubash and Jogesh 2014). While in the existing institutional structure a nodal agency (such as Department of Environment in case of SAPCC) prepares the climate and disaster plans, there is a need for progression towards establishment of climate and disaster cells in the line departments to fully integrate such risks in the development plans. To effectively mainstream adaptation, subsequent iterations of state climate planning should take measures to ensure that adaptation policies do not exacerbate inequalities, identify trade-offs and synergies of different policies through public consultations and multi-criteria decision analysis, and adopt a programmatic approach as against a project approach.

References

- Aggarwal, P.K., A. Jarvis, B.M. Campbell, R.B. Zougmore, A. Khatri-Chhetri, S.J. Vermeulen et al. 2018. 'The Climate-Smart Village Approach: Framework of an Integrative Strategy for Scaling-up Adaptation Options in Agriculture', *Ecology and Society*, 23(1): 14, Available at <https://www.ecologyandsociety.org/vol23/iss1/art14/>.
- Auffhammer, M., V. Ramanathan, and J.R. Vincent. 2006. 'Integrated Model Shows that Atmospheric Brown Clouds and Greenhouse Gases Have Reduced Rice Harvests in India', *Proceedings of the National Academy of Sciences*, 103(52): 19668–72.
- . 2012. 'Climate Change, the Monsoon, and Rice Yield in India', *Climatic Change*, 111(2): 411–24.
- Bahadur, A., E. Lovell, and F. Pichon. 2016. 'Strengthening Disaster Risk Management in India: A Review of Five State Disaster Management Plans', p. 48, Overseas Development Institute.
- Bapuji Rao, B., P. Santhibhushan Chowdary, V.M. Sandeep, V.U.M. Rao, and B. Venkateswarlu. 2014. 'Rising Minimum Temperature Trend over India in Recent Decades: Implications for Agricultural Production', *Global and Planetary Change*, 117: 1–8.
- Bhadwal, S., S. Ghosh, and J. Martin-Ortega. 2011. 'Agriculture', in A. Markandya and A. Mishra (eds), *Costing Adaptation: Preparing for Climate Change in India*. New Delhi: The Energy and Resources Institute.
- Birthal, P.S., T. Khan, D.S. Negi, and S. Agarwal. 2014. 'Impact of Climate Change on Yields of Major Food Crops in India: Implications for Food Security', *Agricultural Economics Research Review*, 27(2): 145–55.
- Blanc, E. and J. Reilly. 2017. 'Approaches to Assessing Climate Change Impacts on Agriculture: An Overview of the Debate', *Review of Environmental Economics and Policy*, 11(2): 247–57.
- Burnham, M., L.V. Rasmussen, and Z. Ma. 2018. 'Climate Change Adaptation Pathways: Synergies, Contradictions and Trade-offs across Scales', *World Development*, 108: 231–4.
- Cole, S., X. Gine, and J. Vickery. 2014. 'How Does Risk Management Influence Production Decisions? Evidence from a Field Experiment', Working Paper 13-080, Harvard Business School, Boston.
- Dell, M., B.F. Jones, and B.A. Olken. 2014. 'What Do We Learn from the Weather? The New Climate–Economy Literature', *Journal of Economic Literature*, 52(3): 740–98.
- Deschênes, O. and M. Greenstone. 2007. 'The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather', *American Economic Review*, 97(1): 354–85.

- Dubash, N.K. and A. Jogesh. 2014. 'From Margins to Mainstream? State Climate Change Planning in India', *Economic & Political Weekly*, 49(48): 86–95.
- Gupta, E., B. Ramaswami, and E. Somanathan. 2017. 'The Distributional Impact of Climate Change: Why Food Prices Matter'. Discussion Papers in Economics 17-01, pp. 1–4. New Delhi: Indian Statistical Institute.
- Gupta, R., E. Somanathan, and S. Dey. 2016. 'Global Warming and Local Air Pollution Have Reduced Wheat Yields in India', *Climatic Change*, 140(3). Available at doi:10.1007/s10584-016-1878-8.
- Gupta, S., P. Sen, and S. Srinivasan. 2014. 'Impact of Climate Change on the Indian Economy: Evidence from Food Grain Yields', *Climate Change Economics*, 05(2), 1450001: 1–29.
- Hanemann, W.M. 2000. 'Adaptation and Its Measurement', *Climatic Change*, 45(3–4): 571–81.
- Jacoby, H., M. Rabassa, and E. Skoufias. 2014. 'Distributional Implications of Climate Change in India: : A General Equilibrium Approach', *American Journal of Agricultural Economics*, 97(4)pp. 1135–56.
- Kar, S. and N. Das. 2015. 'Climate Change, Agricultural Production, and Poverty in India', in A. Heshmati, E. Maasoumi, and G. Wan (eds), *Poverty Reduction Policies and Practices in Developing Asia*. ADB and Springer.
- Klein, R.J.T., K.M. Adams, A. Dzebo, M. Davis, and C.K. Siebert. 2017. 'Advancing Climate Adaptation Practices and Solutions: Emerging Research Priorities', Working Paper No. 2017-07, Stockholm Environment Institute, Stockholm.
- Krishnamurthy, C.K.B. 2012. 'The Distributional Impacts of Climate Change on Indian Agriculture: A Quantile Regression Approach', Working Paper No. 69, Madras School of Economics, Chennai.
- Kumar, K.S. Kavi. 2011. 'Climate Sensitivity of Indian Agriculture: Do Spatial Effects Matter?', *Cambridge Journal of Regions, Economy and Society*, 4(2): 221–35.
- Kumar, K.S. Kavi and J. Parikh. 2001. 'Indian Agriculture and Climate Sensitivity', *Global Environmental Change*, 11(2): 147–54.
- Kumar, K.S. Kavi and B. Viswanathan. 2013. 'Influence of Weather on Temporary and Permanent Migration in Rural India', *Climate Change Economics*, 4(2), 1350007: 1–20.
- Kumar, Vineet. 2018. *Coping with Climate Change: An Analysis of India's State Action Plans on Climate Change*. New Delhi: Centre for Science and Environment.
- Lobell, D.B., W. Schlenker, and J. Costa-Roberts. 2011. 'Climate Trends and Global Crop Production since 1980', *Science* 333(6042): 616–20.

- Mall, R.K., A. Gupta, and G. Sonkar. 2017. 'Effect of Climate Change on Agricultural Crops', in S.K. Dubey, A. Pandey, and R.S. Sangwan (eds), *Current Developments in Biotechnology and Bioengineering: Crop Modification, Nutrition, and Food Production*. Elsevier. Available at doi:10.1016/B978-0-444-63661-4.00002-5.
- Mechler, R. and T. Schinko. 2016. 'Identifying the Policy Space for Climate Loss and Damage', *Science*, 354(6310): 290–2.
- Mendelsohn, R., W.D. Nordhaus, and D. Shaw. 1994. 'The Impact of Global Warming on Agriculture: A Ricardian Analysis', *The American Economic Review*, 84(4): 753–71.
- Mobarak, A.M. and M. Rosenzweig. 2012. 'Selling Formal Insurance to the Informally Insured', Economics Department Working Paper No. 97, Yale University, New Haven.
- Naresh Kumar, S., P.K. Aggarwal, D.S. Rani, R. Saxena, N. Chauhan, and S. Jain. 2014. 'Vulnerability of Wheat Production to Climate Change in India', *Climate Research*, 59(3): 173–87.
- Naresh Kumar, S., P.K. Aggarwal, R. Saxena, D. Swaroopa Rani, S. Jain, and N. Chauhan. 2013. 'An Assessment of Regional Vulnerability of Rice to Climate Change in India', *Climatic Change*, 118(3–4): 683–99.
- National Academy of Agricultural Sciences (NAAS). 2013. 'Climate Resilient Agriculture in India', Policy Paper 65, NAAS, New Delhi.
- Nelson, G.C., M.W. Rosegrant, J. Koo, R. Robertson, T. Sulser, T. Zhu, et al. 2009. *Climate Change Impact on Agriculture and Costs of Adaptation*. Washington, DC: International Food Policy Research Institute. Available at http://www.fao.org/fileadmin/user_upload/rome2007/docs/Impact_on_Agriculture_and_Costs_of_Adaptation.pdf
- O'Brien, K., R. Leichenko, U. Kelkar, H. Venema, G. Aandahl, H. Tompkins, A. Javed, S. Bhadwal, S. Barg, L. Nygaard, and J. West. 2004. 'Mapping Vulnerability to Multiple Stressors: Climate Change and Economic Globalization in India', *Global Environmental Change*, 14(4): 303–13.
- Palanisami, K., D. Suresh Kumar, R.P.S. Malik, S. Raman, G. Kar, and K. Mohan. 2015. 'Managing Water Management Research: Analysis of Four Decades of Research and Outreach Programmes in India', *Economic & Political Weekly*, 50(26–7): 33–43.
- Pattanayak, A. and K.S. Kavi Kumar. 2014. 'Weather Sensitivity of Rice Yield: Evidence from India', *Climate Change Economics*, 5(4), 1450011: 1–24.
- . 2017. 'Does Weather Sensitivity of Rice Yield Vary Across Regions? Evidence from Eastern and Southern India', Working Paper WP-162, Madras School of Economics, Chennai.

- Pervin, M., S. Sultana, A. Phirum, I.F. Camara, V.M. Nzau, V. Phonnasane, P. Khounsny, N. Kaur, and S. Anderson. 2013. 'A Framework for Mainstreaming Climate Resilience into Development Planning', International Institute for Environment and Development (IIED) Working Paper, Climate Change, November.
- Rama Rao, C.A., B.M.K. Raju, A.V.M. Subba Rao, K.V. Rao, V.U.M. Rao, K. Ramachandran, B. Venkateswarlu, A.K. Sikka, M. Srinivasa Rao, M. Maheswari, and Ch. Srinivasa Rao. 2016. 'A District Level Assessment of Vulnerability of Indian Agriculture to Climate Change', *Current Science*, 110(10): 1939–46.
- Sanghi, A. and R. Mendelsohn. 2008. 'The Impacts of Global Warming on Farmers in Brazil and India', *Global Environmental Change*, 18(4): 655–65.
- Saravanakumar, V. 2015. 'Impact of Climate Change on Yield of Major Food Crops in Tamil Nadu, India', Working Paper No. 91-15, South Asian Network for Development and Environmental Economics.
- Saseendran, A.S.K., K.K. Singh, L.S. Rathore, S.V. Singh, and S.K. Sinha. 2000. 'Effects of Climate Change on Rice Production in the Tropical Humid Climate of Kerala, India', *Climatic Change*, 44: 495–514.
- Swaminathan, M.S. and P.C. Kesavan. 2012. 'Agricultural Research in an Era of Climate Change', *Agricultural Research*, 1(1): 3–11.
- Venkateswarlu, B., A.K. Shankar, and A.K. Gogoi 2011. 'Climate Change Adaptation and Mitigation in Indian Agriculture', in G.S.L.H.V. Prasad Rao (ed.), *Climate Change Adaptation Strategies in Agriculture and Allied Sectors*, Scientific Publishers India, pp. 85–95.
- Viswanthan, B. and K.S. Kavi Kumar. 2015. 'Weather, Agriculture and Rural Migration: Evidence from State and District Level Migration in India', *Environment and Development Economics*, 20(4): 469–92.
- Zilberman, D., J. Zhao, and A. Heiman. 2012. 'Adoption versus Adaptation, with Emphasis on Climate Change', *Annual Review of Resource Economics*, 4: 27–53.

Shoring Up

Climate Change and the Indian Coasts and Islands

Rohan Arthur

As the science fiction prophet Douglas Adams well knew, the secret to invisibility was magnitude. The only way to reconcile the cognitive dissonance of immensity is to deny its existence. As an undefined force that acts at scales inconceivably larger than typical ecological, social, economic, or historical processes, accepting that climate change is now one of the primary drivers of these processes is not easy. A similar cloak of invisibility shrouds the global oceans. Our knowledge of ocean processes declines exponentially as we dive below the photic zone, rendered more than metaphorically invisible. It is scarcely surprising then that in public discourse in India, the impact of climate change on the oceans is an invisible force acting on an invisible space.

In reality, the ocean is a central regulatory organ of climate; anthropogenic modifications of oceanic processes can result in major disruptions in this regulatory function. On coasts and oceanic islands, these disruptions are being experienced first-hand, even if it

is difficult at smaller scales to link them back to a changing climate. Coasts are naturally dynamic, but their resilience is quickly unravelling as oceanic currents, surface temperatures, weather patterns, and ecosystem function all respond to rapid environment change. Populations congregate thickly within 100 km of the coast (Small and Nicholls 2003), placing coastal communities at the highest risk. Low-lying oceanic islands are at one extreme of this vulnerability and are the first to experience the first and higher-order impacts of climate change (Barnett and Adger 2003; Duvat et al. 2017; Storlazzi et al. 2015). India's coastline stretches for more than 7,500 km and coastal districts house roughly 17 per cent of its population. More than 250 million people crowd within 50 km of the coast, a fifth of it concentrated in the megacities of Mumbai, Kolkata, and Chennai (Sudha Rani, Satyanarayana, and Bhaskaran 2015). While coastal cities present a unique set of problems, the entire coastline is subject to the impacts of climate change.

I will briefly describe the essential services that coastal ecosystems supply and the principal climate-related threats to them. I will then explore policy responses to climate vulnerability. Using a case study from Lakshadweep archipelago, I will examine the responses of low-lying atolls to climate change. Finally, I will discuss what mainstreaming coastal climate vulnerability in public policy would require.

Coastal Ecosystems and the Services They Provide

Humans flock to coastlines for a reason. Coastal systems are rich in resources, offering a wide array of provisioning services that sustain livelihoods. Marine fisheries are completely dependent on the productivity of these systems. India extracts about 3.63 metric tonnes per year of fish, squid, and shrimp from its exclusive economic zone—the third-largest capture fishery in Asia, the seventh worldwide (Fishery Resources Assessment Division [FRAD] 2017). From being largely artisanal in the 1950s, the fishery has rapidly industrialized and diversified with intensive mechanization. As near-shore ecosystems deplete, mid-water and deep-sea communities are being increasingly targeted. The boundaries between small-scaled artisanal and large industrial fleet fishing are fuzzy as the sector connects to international markets.

From daily subsistence to factory production, the fishery is completely dependent on the services that ocean and coastal ecosystems provide. In addition though, these systems support important regulatory, supporting, and cultural services vital to coastal livelihoods, summarized in Table 29.1. Many coastal and pelagic ecosystems are important carbon sinks, capturing atmospheric carbon, burying it in sediments or transporting it deeper. Seagrasses, mangroves, and salt marshes have some of the highest sequestration rates globally. They are, therefore, important organs in the global biosphere, helping offset greenhouse gas emissions. When they are lost or degraded, they lose centuries of carbon reservoirs along with their sequestration abilities. Worse, they may even become net emitters of carbon and methane, compounding climate change impacts.

Impacts of Climate Change on Coastal and Marine Systems

We are still relatively new colonizers of the sea. While anthropogenic species' extinction started almost 100,000 years ago on land, only in the last few centuries have we been exterminating marine species sufficiently to be noticed. This is no reason for complacency—marine defaunation has increased dramatically in the last decades as we rapidly industrialize the sea (McCauley et al. 2015). How much this loss can be attributed to climate change alone is difficult to ascertain. Climate change is one among several interacting drivers defining the characteristically human signature of the Anthropocene. Mapping the global human footprint on oceanic systems, Halpern and others identify only 3 uniquely climate-related drivers (sea-level rise, ultraviolet radiation, and ocean acidification) among the 17 they list (Walbridge et al. 2008). However, apart from being a distinct agent of environmental variation, climate change pervades non-climate drivers as well. In turn, many of these factors contribute to positive feedbacks in climate trajectories, further destabilizing the self-regulatory capacity of whole-earth system dynamics.

Species and Ecosystem Responses

It is difficult to completely disentangle the influence of climate change from non-climate drivers in determining current

Table 29.1 Major Coastal and Marine Ecosystems in India, Their Principal Threats, and the Services They Provide to Human Communities

System	Distribution	Threats and Status	Ecological Goods and Services		
			Provisioning	Regulatory and Supporting	Cultural
Landward					
Mangrove forests	In pockets on both coasts and in island systems. Extensive in the Sundarbans.	Threats: Habitat conversion, logging, pollution, overfishing, sea-level rise, other climate-related effects. Status: Drastic reduction across India, restoration efforts at several locations.	1. Fish and shellfish 2. Timber 3. Mixed agriculture, aquaculture	1. Coastal protection 2. Erosion control 3. Pollution control 4. Carbon sequestration 5. Fish nurseries 6. Nutrient cycling	1. Sacred sites 2. Tourism 3. Large channels used as waterways for transport
Sand dunes and beaches	1. Beaches abundant on coasts and islands. 2. Dunes are patchily distributed, more on east coast.	Threats: Habitat conversion, beach hardening/coastal development, vegetation loss, sand mining, sea-level rise. Status: Dunes largely destroyed/converted, beaches still abundant.	1. Sand and minerals 2. Agriculture on landward side	1. Coastal protection and wind breaks 2. Erosion control 3. Water catchment 4. Pollution control 5. Small carbon sequestration ability when vegetated 6. Turtle nesting sites	1. Boat landing sites 2. Post-harvest areas (sorting, drying, packaging, and so on) 3. Beach tourism

Salt marshes	Limited distribution, mostly Gujarat, but also Tamil Nadu and Andhra Pradesh.	Threats: Habitat conversion, aquaculture, cattle grazing, hydrological and salinity changes, invasive species, pollution, sea-level rise, other climate-related effects. Status: Limited information.	Cattle fodder	<ol style="list-style-type: none"> 1. Coastal protection 2. Erosion control 3. Pollution control 4. Extremely high carbon sequestration capacity 5. Nurseries for crustaceans, fish 6. High bird diversity 	Bird watching tourism
Seaward					
Sedimentary habitats	Extensive on continental shelf.	Threats: Trawling, pollution. Status: Limited information despite high dependence.	<ol style="list-style-type: none"> 1. Shrimp, other invertebrates 2. Bottom-dwelling fish 	<ol style="list-style-type: none"> 1. Potentially high carbon sequestration 2. Pollution metabolism and burial 3. Filtering can help water clarity 4. Nutrient cycling 	None
Seagrass meadows	Gulf of Mannar/ Palk Bay; Andaman & Nicobar Islands; Lakshadweep. Patchy meadows elsewhere.	Threats: Sedimentation, fragmentation, pollution, invasive algae, climate change impacts equivocal. Status: Major decline across India.	Fisheries	<ol style="list-style-type: none"> 1. Coastal protection 2. Erosion control 3. Potentially very high carbon sequestration capacity 4. Fish and invertebrate nurseries 5. Nutrient cycling 	Tourism benefits equivocal (seagrass cast often disliked by tourists)

(cont'd)

Table 29.1 (cont'd)

System	Distribution	Threats and Status	Ecological Goods and Services		
			Provisioning	Regulatory and Supporting	Cultural
Coral reefs	Atoll and fringing reefs on oceanic islands, Gulf of Mannar/Palk Bay; patch reefs in Gulf of Kutch; smaller reef formations elsewhere; unexplored banks off west coast.	Threats: Overfishing, sedimentation, pollution, climate-related increases in sea surface temperatures, ultraviolet radiation, ocean acidification. Status: Highly threatened globally and in India.	1. Fisheries (about 12% of global production) 2. Octopus, sea cucumber, shellfish, and so on. 3. Aquarium species 4. Calcium carbonate for construction	1. Coastal protection 2. On atolls, critical for island formation and maintenance 3. Unclear if net source or sink of carbon 4. Fish nurseries 5. Nutrient cycling 6. High diversity	Tourism
Pelagic waters	Widespread	Threats: Overfishing, pollution (oil spills, ship transport, plastics, etc), changing ocean currents, other climate change effects. Status: Slated for exponential increase in exploitation.	Pelagic fisheries	1. High carbon storage capacity 2. Pelagic phytoplankton, main engine of primary production in the sea 3. Nutrient cycling 4. Habitat for iconic pelagic species	1. Religious, mythological, and literary symbolism 2. Global transport 3. Cruise and sport tourism

Source: Banerjee et al. (2017), Barbier et al. (2011), Holmlund and Hammer (1999), Moberg and Folke (1999), Patro et al. (2017), and Snelgrove (1999), among others.

environmental and socio-ecological trends. The uniquely climate-related drivers on marine and coastal systems include: (i) sea-level rise; (ii) increasing sea surface temperature; (iii) oceanic current disruption; (iv) ocean acidification; and (v) intensity and frequency of unusual weather events. These interact in complex ways, amplifying or dampening each other's influence. Together they trigger a host of first-order effects—directly influencing species physiologies, life histories, survival rates, population trends, movement and migration patterns, species interactions, and habitat condition. Species cope differentially with the intensity and rapidity of these changes, creating winners and losers as better-adapted opportunists outcompete specialists. For instance, with increasing tropicalization of subtropical and temperate waters, ranges of tropical fish, coral, algae, and other invertebrates are expanding rapidly; freed from their usual predators and competitors, these invaders can quickly transform these new environments (Vergés et al. 2014). More typically though, ocean and coastal waters are witnessing alarming declines. Over the last six decades, phytoplankton have reduced by up to 20 per cent in the Indian Ocean—caused by increased stratification in ocean layers as a result of ocean warming (Roxy et al. 2016). This warns of a rapid expansion of a marine desert in the Indian Ocean as the principal engine of ocean productivity shuts off. At the other extreme, highly eutrophic and hypoxic dead zones are spreading across the world's oceans, including the Bay of Bengal, caused by land-based fertilizers and other chemical pollutants pouring into the sea (Bristow et al. 2016; Diaz and Rosenberg 2008). Between declining productivity and hypoxia, the Indian Ocean is showing evident signs of stress. These decadal trends become dramatically obvious as global oceanic patterns break down—the clearest being the increasingly erratic El Niño Southern Oscillation (ENSO). This current of unusually warm water pouring in from the Pacific is caused by changes in oceanic winds, with pan-tropical impacts. Since the 1990s, the Indian Ocean has experienced at least four high-intensity ENSO events; apart from being a strong driver of the Indian monsoon, it results in mass coral mortalities in tropical reefs (Baker et al. 2008; Descombes et al. 2015).

Interconnectedness

The coast is an area of busy transitions, an abundance of ecosystems, often part of a connected matrix of habitats. There is a constant transfer of material and energy within this fluid matrix. While a large part of this flow is because of oceanographic connectivity, much of it is transported by marine biota—both mobile and sedentary species move between ecosystems at some time in their life cycle. For instance, a fish may start life in the plankton in open pelagic waters, recruit in coastal mangroves, migrate back again to pelagic waters as an adult, occasionally visiting coral reefs to feed. Birds, turtles, and other marine megafauna can connect otherwise highly separated ecosystems—nesting, travelling, and foraging in locations hundreds or thousands of kilometres apart (Lundberg and Moberg 2003). This unique connectedness also links their ecological fates; impacts on one system can have significant flow-on consequences for several others.

Non-linear Ecosystem Properties

Many marine and coastal ecosystems do not respond in predictable, linear ways to increasing stress (Hewitt, Ellis, and Thrush 2016). Coral reefs, rocky beds, and pelagic systems all show complex dynamics that, under normal conditions, are held together with negative feedbacks—internal regulatory mechanisms that prevent the system from careening off on hard-to-control trajectories (Holbrook et al. 2016; Holling 1973). When these homeostatic feedbacks are disturbed, the natural buffer capacity of the system is compromised—beyond a threshold, the system collapses, often catastrophically, without much hope of recovery. We are only just coming to grips with non-linear ecosystem behaviours and are yet unable to predict system shifts before they occur.

Review of Indian Research on Climate Change Impacts

There is little first-hand research from India directly addressing climate-change consequences on marine ecosystem dynamics. The bulk of Indian research documents changes to sea-level and weather patterns, and evaluates coastal vulnerability. These studies indicate a 3.2 millimetres per year (mm.yr^{-1}) increase in mean sea-level along the

coast (tracking global averages), with the Bay of Bengal experiencing approximately 5 mm.yr^{-1} increase over the last two decades (Nidheesh et al. 2017; Unnikrishnan and Shankar 2007). This is linked to a weakening monsoon (documented since the 1950s), which causes oceanic heat retention, thermal expansion, and a consequent sea-level rise in the northern Indian Ocean (Swapna et al. 2017). The weakening monsoon rides tandem with fewer cyclones that are significantly more destructive when they do occur. Recent unusually severe cyclonic activity in the Arabian Sea has a distinct human signature that is quickly becoming the new normal (Murakami, Vecchi, and Underwood 2017). Coupled with sea-level rise, this makes Indian coastal zones increasingly vulnerable to strong storm surge activity.

The tsunami of 2004 severely tested India's coastal defences and found it seriously wanting (Sudha Rani, Satyanarayana, and Bhaskaran 2015). In its wake, a host of studies emerged, mapping coastal vulnerability to storm surges and sea-level rise. Typically, these studies combine satellite imagery, hydrography, and (less frequently) field surveys to map coastal habitats and built-up areas. These maps are modelled against projected rates of sea-level rise, coastal erosion, and storm surge intensity/frequency to determine the relative susceptibility of different parts of the coastline to climate (and related) drivers. The findings are meant to feed into development plans at state and national levels. How much they actually influence on-ground policy is an open question.

We know little of how ocean acidification influences systems in India. Increased atmospheric carbon dioxide (CO_2) changes ocean chemistry, causing an overall decrease in pH. By depleting carbonate ion concentrations and lowering carbonate saturation states, acidification reduces the accretion of species with external skeletons of calcium carbonate (CaCO_3) (plankton, crustaceans, molluscs, coral, and so on). This makes them particularly vulnerable to breakage. With structural species like coral, this translates to increasingly fragile reefs that crumble with every storm. Recent studies have shown that even non-calcifiers are likely to be affected by increasingly acidic environments, seriously affecting the chemosensory and visual responses of fish, increasing their predation risk (Ferrari et al. 2012).

As discussed, these drivers interact with non-climate drivers, influencing near-shore and oceanic ecosystems. While it is difficult to

disentangle their effects, it is naïve to ignore them when attempting to understand climate change consequences to the coast. One important reason to pay attention to non-climate drivers is to overcome the resigned paralysis of scale that climate change tempts us to retreat to. Regional/local management can seldom tackle the magnitude of climate change, but it is clear that social–ecological resilience to climate variability is strongly mediated by local factors. For instance, reef recovery after catastrophic coral bleaching is strongly linked to sedimentation caused by land use change. Reducing sediment stress may not address the underlying climate-related drivers of bleaching, but may make the difference between reefs succumbing or recovering from bleaching events. While climate change is global in its causes, its impact is always experienced locally—and locally contingent factors are vital to how the system responds. Managing for climate change, then, is best imagined as an enterprise in enhancing the resilience of every sector of the coast and its ecosystems, with climate variability as a critical (often capricious) driver influencing the overall buffer capacity of the system.

India's Climate Change Preparedness

The all-pervasive nature of climate change requires a coherent, planned, and integrated coast-wide response to be effective. When evolving a regional climate change strategy, two factors should be kept front and centre. First, climate and non-climate drivers are intrinsically interconnected; oceanographic ecological and socio-political processes interact in complex ways. Second, human ecological systems are inherently non-linear in behaviour; it is seldom easy to predict future trajectories based merely on past and present performance. These characteristics make linear symptomatic approaches ineffectual; resilience planning instead requires understanding stability dynamics and reimagining the spatial and temporal scale of management to match them. For example, stabilizing structures may not address eroding beaches if natural sand depositional patterns function at much larger scales. Resilience planning requires particular vigilance for telltale signs of criticality, that is, behaviours that presage imminent shifts in human ecological systems (Andersen et al. 2009; Carpenter et al. 2013; Rothman 2017; Thrush et al.

2009). These indicators would ideally alert regional managers to take proactive steps to address the local stressors pushing systems towards potentially catastrophic shifts.

How far is this vision from reality in India? Climate change is only relatively recent in India's policy debate. The country is still evolving a unified response, with one eye on the international community and another firmly on its own developmental agenda. With other nations, namely, Brazil, South Africa, and China, India's stance has evolved from an initially prickly and defensive one to a considerably more nuanced stand that attempts to resolve the trilemma of meeting environmental, developmental, and equity requirements (Dubash 2016). India's policy is outlined in the National Action Plan on Climate Change (NAPCC) and state-level action plans, that is, State Action Plans on Climate Change (SAPCCs). The focus is clearly on technological fixes, market mechanisms, and sustainable development, building a climate change response around eight national missions (see Dubash and Ghosh, Chapter 19 in this volume). Himalayan ecosystems and forests feature prominently as separate national missions; the oceans and coasts are conspicuous by their absence. This blind spot is alarming given how disproportionately climate change is likely to impact ecosystems and communities along the coast. The NAPCC provides for coastal protection only as part of 'other initiatives', listing setback lines recommended in the Coastal Regulation Zone (CRZ) notification as a guidance instrument. The better part of the strategy, however, is linked to investments in coastal defences, salt-tolerant crops, and coastal afforestation. Fisheries merit no mention whatsoever, either within the sustainable agriculture mission (within whose ambit it could likely fall) or in the coastal protection provisions.

As envisioned, most sectors likely affected by climate change are state subjects, and most coastal states (with the exception of Goa and Daman and Diu) have developed their own action plans (SAPCCs).¹ While these plans come within the purview of the Ministry of Environment, Forest and Climate Change (MoEFCC), little clarity exists on how states should coordinate strategies and responses. It is even less clear how the MoEFCC will realistically steer independent

¹ See <http://www.moef.nic.in/ccd-sapcc>.

ministries towards a common climate-change mandate. It is argued that the SAPCCs could be crucibles of locally contingent creativity, adapting the vision of the NAPCC to local resilience needs. However, this vision is very far from the hastily produced reality of the SAPCCs accepted by the centre.

While (unlike the NAPCC) all states explicitly highlight coastal vulnerability, the means identified to tackle it is by advancing developmental agendas even further. In evaluating coastal vulnerability, SAPCCs rely either on sparse locally relevant information or on coarse global projections. Sea-level rise, storm surges, saline ingress, and coastal erosion are common themes identified in most coastal SAPCCs, but few have good current estimates of how these will influence their coasts. For instance, without local sea-level rise estimates, Gujarat defaults to global estimates to frame its vulnerability (Government of Gujarat 2014). Tamil Nadu relies on a single (wrongly cited and interpreted) source (Cheung et al. 2009) to project a 50 per cent *increase* in near-shore pelagic fish productivity (Government of Tamil Nadu 2014) and to develop a strategy to track this bonanza: promoting deep-water fishing; mid-water processing units; and other intensification strategies. This, in fact, is not unique to Tamil Nadu. In my reading of SAPCCs, every coastal state proposes to deal with potential climate change impacts on fisheries with two broad strategies: enhancing and maximizing catch by upgrading fisheries technologies and infrastructure; and actively promoting aquaculture and mariculture. Thus, while tropical fisheries are poised on the brink of ecological collapse, SAPCCs would see a further intensification (rather than restricted harvesting) of these resources. Like most other provisions in the SAPCCs, this represents an uninterrupted expansion of growth trajectories that each state was already on, flying in the face of most scientific evidence. A similarly unifying theme is the reforestation/afforestation of mangroves and coastal forests, as coastal shelter belts, nurseries for fisheries, and as carbon sinks. Although refurbished with the language of climate change, this is merely an extension of an unchanging forest department strategy (Mukherjee et al. 2010); without careful thought and implementation, they often do more harm by interfering with natural processes (Feagin et al. 2010).

Between the narrow sector-wise framing of current policy reflected in the SAPCCs and our laggard climate science, it is

difficult to imagine how India's response can translate to a cogent climate-resilient strategy. However, given the uncertainty of climate change responses, a coordinated resilience response is our best hope for managing current and future change to oceans and coasts.

Case Study: The Lakshadweep Archipelago as a Harbinger of Things to Come

The Lakshadweep archipelago is a bellwether of future climate change impacts. As low-lying densely populated coral islands, it is a perfect prism to examine how coastal ecosystems, human communities, and local governments are responding to ongoing climate change. Composed almost exclusively of coral sand, the islands rely on a constantly growing atoll framework to ensure that lagoons remain calm even during the stormy monsoons. Calm lagoons also protect fresh groundwater lenses from saline intrusion (Storlazzi et al. 2018). Therefore, for Lakshadweep, habitability is dictated by reef health.

Lakshadweep reefs have been subject to increasingly frequent ENSO events, resulting in large-scale coral bleaching and mortality. Within the last two decades, the archipelago has witnessed three catastrophic mass mortalities, in 1998, 2010, and 2016 (Arthur 2000, 2015). The overall observations over the last 20 years are indeed sobering. Even without significant local impacts, fish communities have changed radically, with many top predators disappearing rapidly from all except the most stable reefs (Alonso et al. 2015; Karkarey et al. 2014). Alarming, reefs have declined by nearly 78 per cent since 1998 and at current rates, may no longer have the capacity to keep up with natural erosion. This means that the reef frameworks that sustain calm lagoons, land stability, and groundwater supplies are already significantly compromised. Long before sea-level rise, the Lakshadweep Islands may become uninhabitable once land and freshwater become limiting. Supporting dense human populations may no longer be viable and the Lakshadweep populations may well be among India's first climate refugees.

What are local community and government responses to this unfolding crisis? Most Lakshadweepans will have heard about climate change, but for most, fishers included, its impacts are understood

in vague terms. There certainly isn't any sense of urgency in the discourse over climate change, nor the sense that their own choices can influence the trajectories their human ecological system takes (Kelman et al. 2017). Islanders seem unable or unwilling to link their own day-to-day experiences or decisions with the imminent climate disaster that mills around them. A sign of this disconnect is a recent rise in commercial reef fishing at a time when reefs are reeling from major coral mortalities. The exponential growth of this fishery threatens to unravel the already fragile resilience of the Lakshadweep reefs. Confronted with visible signs of climate change impacts, like eroding beaches, reducing fresh water, or declining reefs, the community sees this as a problem for the government to fix. Despite recent attitudinal shifts, the surrender of individual agency to government institutions derives from a long subsidy culture on which government–community relationships are constructed. This serves to disconnect local communities from their social–ecological system, and facilitates the nebulous understanding islanders have towards climate change.

The response of the administration is equally ambiguous. While every government department lists climate change as a priority, their responses are reactive, often pulling in different directions. The Lakshadweep Action Plan for Climate Change (LAPCC) reflects this ambiguity. Acknowledging reef vulnerability, the document proposes further increasing fisheries capacity without any mechanisms for regulating harvest. All other strategies dealing with climate impacts rely on technological fixes, such as beach stabilization measures, desalination plants, and reef restoration. Climate change has seriously reduced the safe operating space for further development in Lakshadweep, but while government policy acknowledges the problem, it barrels on its own developmental paths—only with greater intensity. As it stands, Lakshadweep is hurtling towards disaster with climate change sitting doggedly in its blind spot.

Building Climate Resilience for Indian Coasts and Islands

Even if the Paris treaty does not get unstuck by global politicking and inefficiencies of implementation, anthropogenic climate change will still be the dominant agent of environmental and social change.

The proposed cap of 1.5°C (even if achievable) will not give marine ecosystems like coral reefs sufficient time to adapt (van Hooidonk et al. 2016). Already, the return time of ENSOs has reduced to once in every 6 years, signalling a shift to a new normality for marine systems (Cai et al. 2014; Hughes et al. 2018). The difficulty of mainstreaming climate change in public discourse is one of making the self-evident visible. Intergovernmental responses have been exercises in political accountancy, yet, while India carves out its global stance, asserting its right to emit and ‘sustainably’ develop, little serious thought has been invested in how to establish social–ecological safeguards to address the impacts of developmental trajectories on coastal systems. As discussed earlier, while the forces of global change (both climate and non-climate driven) are apparently inexorable at local levels, resilient systems resist, recover, and adapt better in the face of rapid environment change. Resilience is highly contingent on local situations and needs to be understood and managed at ecologically or socially relevant scales. Rather than absolving coastal managers of responsibility, climate resilience places the onus on them to protect and enhance the social–ecological resilience of coastal and oceanic systems.

Managing social and ecological interface areas is seldom easy. Coasts are where the needs of ecosystem protection collide with local livelihoods, fisheries, shipping, development, mineral exploration, and national defence. Climate change affects each of these in potentially unpredictable ways; and the way states have chosen to address this is by parcelling out responses to relevant government departments, without explicit mechanisms of aligning mandates or coordinating responses between departments or across state boundaries. This is particularly relevant for ecosystems and species that span multiple states, traversing multiple legislative and policy boundaries. While it may appear unreasonable to expect a radical shift in inter-departmental coordination under current governance structures, the central properties of complex coastal systems—non-linearity and interconnectedness—make coordination inescapable to adequately build climate resilience into policy. The challenge for coastal planners is to translate these system properties into workable government plans. The contours of a climate-ready plan require a set of phased strategies to support natural buffer capacity and to improve recovery

when disasters do occur. While maximizing social–ecological resilience should be central to a climate-ready strategy, it will also need adequate back-up strategies in case these first-line measures fail.

Maximizing Social–Ecological Resilience

A useful way to conceive how social–ecological resilience can inform management is to think of climate change and ecosystem integrity as defining the safe operating space within which all human activities—extractive and non-extractive—need to be managed. Often, departmental mandates over the same resource space differ widely, as the need to conserve and safeguard these resources confronts the urge to intensify production or maximize use. Finding a negotiated middle ground between departmental goals is essential. However, these departmental mandates and developmental goals need to work within the boundary conditions set by the social–ecological system itself. These are non-negotiable system boundaries, beyond which the social–ecological system behaves erratically, becoming prone to sudden shifts and inevitable surprises. In real terms, this could mean reefs shifting to algal dominance, a fishery collapse, a disease outbreak, a violent resource conflict, or a sudden migrant rush. As can be imagined, none of these happen in exclusion—they are often multi-sectoral problems that require a multi-sectoral response. Thus, a coral reef regime shift (the mandate of local environment departments) may trigger a fisheries collapse (the mandate of fisheries departments), which could result in conflict between fishers (a law-and-order matter), leading to a host of other societal problems with unforeseen consequences. Sufficiently healthy social–ecological systems will have enough self-corrective properties to buffer such disturbances without showing radical system shifts.

Maintaining systems within regimes of stability is central to resilience management. Resilience thinking needs to underlie policy directions of every concerned coastal institution. Of course, this assumes that we understand how climate change is modifying system boundary conditions—knowledge currently lacking for most coastal and marine systems in India. In addition, central to any resilience management is a monitoring designed to alert managers of approaching criticalities, and a clear mechanism of

prophylactic response before thresholds are breached. While a lot of attention focuses on governmental responses, the communities most directly affected often have effective institutions and mechanisms to monitor and adapt to change. Identifying these institutions and giving them a stronger voice in decision making can often be more effective than top-down governmental initiatives. Where these formal and informal local institutions have eroded, it may require active efforts in rebuilding them and giving them agency over their coastal resources.

Back-up Strategies for Climate Change

Resilience planning works with the assumption that healthy ecosystems and communities will deal better with inevitable climate change. However, a set of back-up strategies is critical in case this first line of defence fails. These are not mutually exclusive with resilience planning, but need to be deployed with much more caution. This includes:

1. *Climate defence strategies*: Designing ecologically sensitive and reliable engineering solutions to protect communities from climate change impacts. For instance, severe coastal erosion requires coastal stability measures, but exactly where those efforts should be employed should be informed by a deeper understanding of coastal sediment dynamics. In considering defence strategies, working *with* rather than *against* natural dynamics should always be the preferred option. In this context, mangrove afforestation/restoration (a strategy proposed by all coastal states) makes sense only if the initial causes of degradation have first been adequately addressed. Typically, when this is done, many coastal systems (mangroves, dunes, seagrasses, reefs, and so on) appear to be quite capable of restoring themselves without further engineering. Only when these efforts fail or are inadequate should more invasive artificial measures be considered—these typically work against natural dynamics, resulting in an unravelling of a host of system properties that are difficult to determine a priori.
2. *Retreat strategies*: In the long term, near-shore areas of coasts and islands will become progressively uninhabitable due to

sea-level rise, storm surges, cyclones, and erosional processes, among others. Over the next century, coastal retreat will be unavoidable. This could happen gradually as individual families find conditions increasingly inhospitable, or as large-scale migrations of entire communities to less-vulnerable areas. In the case of oceanic islands like Lakshadweep, the horizon for retreat is much shorter since the processes of reef erosion, land loss, and saltwater intrusions have already begun. What may be a necessity within three to four generations on the coast may be a more immediate concern for Lakshadweep populations (see the case study). This large-scale population redistribution will require careful planning if it has to be managed without chaos. It is unclear if current policies on internal migration take full cognizance of the scale of human movement that climate change could imply—and whether inland areas are adequately prepared (infrastructure, societal carrying capacity, and so on) to receive this huge influx of people.

3. *Disaster management:* The coast already faces increasingly frequent and intense weather events. India woke up to the need for disaster management after the 2004 tsunami that showed how unprepared the coast was to large-scale disasters. In its wake, coastal states made serious attempts to review their own disaster preparedness. In the climate regime we are heading towards, we will employ these disaster plans much more frequently as flooding events, storm damage, disease outbreaks, and air pollution increase in coastal areas. While megalocities will face the brunt of these disasters, isolated areas face unique challenges since getting first-response and rescue material to them is seldom easy.

The Nation with Its Back to the Sea

Climate change is already a major agent of change on India's coasts and islands, and its ecosystems and local communities are struggling to cope. Our oceanic islands may already be outside safe operating spaces, and they are poised for imminent collapse. Shifting urgently towards a rational, inclusive, and coordinated resilience response is critical. Our current response is as far from this as it is possible to be: it is incoherent, fractured, uncoordinated, and pulling in different

directions. If national policy is any indicator, we are a nation with its back to the sea. Before we can make climate resilience central to the management of ocean and coastal systems, we will first have to address this blind spot and embrace the connectivity and non-linearity of these systems. Islands and coasts are where the impacts of climate change first manifest. If we learn to handle it here, it may have important lessons for climate readiness across India.

References

- Alonso, David, Aleix Pinyol-Gallemí, Teresa Alcoverro, and Rohan Arthur. 2015. 'Fish Community Reassembly After a Coral Mass Mortality: Higher Trophic Groups Are Subject to Increased Rates of Extinction', *Ecology Letters*, 18(5): 451–61. Available at doi:10.1111/ele.12426.
- Andersen, Tom, Jacob Carstensen, Emilio Hernández-García, and C.M. Duarte. 2009. 'Ecological Thresholds and Regime Shifts: Approaches to Identification', *Trends in Ecology and Evolution*, 24(1): 49–57. Available at doi:10.1016/j.tree.2008.07.014.
- Arthur, Rohan. 2000. 'Coral Bleaching and Mortality in Three Indian Reef Regions during an El Niño Southern Oscillation Event', *Current Science*, 79(12): 1723–9.
- . 2015. 'Accidents of History', *Seminar*, 673(September): 59–63.
- Baker, Andrew C., Peter W. Glynn, and Bernhard Riegl. 2008. 'Climate Change and Coral Reef Bleaching: An Ecological Assessment of Long-Term Impacts, Recovery Trends and Future Outlook', *Estuarine, Coastal and Shelf Science*, 80(4): 435–71. Available at doi:10.1016/j.ecss.2008.09.003.
- Banerjee, Kakolee, Swati Mohan Sappal, Purvaja Ramachandran, and R. Ramesh. 2017. 'Salt Marsh: Ecologically Important, Yet Least Studied Blue Carbon Ecosystems in India', *Journal of Climate Change*, 3(2): 59–72. Available at doi:10.3233/JCC-170014.
- Barbier, Edward B., Sally D. Hacker, Chris Kennedy, Evamaria W. Koch, Adrian C. Stier, and Brian R. Silliman. 2011. 'The Value of Estuarine and Coastal Ecosystem Services', *Ecological Monographs*, 81(2): 169–93. Available at doi:10.1890/10-1510.1.
- Barnett, Jon and W. Neil Adger. 2003. 'Climate Dangers and Atoll Countries', *Climatic Change*, 61(3): 321–37. Available at doi:10.1023/B:CLIM.0000004559.08755.88.
- Bristow, L.A., C.M. Callbeck, M. Larsen, M.A. Altabet, J. Dekaezemacker, M. Forth, M. Gauns, et al. 2016. 'N₂ Production Rates Limited by

- Nitrite Availability in the Bay of Bengal Oxygen Minimum Zone', *Nature Geoscience*, 10(1): 24–9. Available at doi:10.1038/ngeo2847.
- Cai, Wenju, Simon Borlace, Matthieu Lengaigne, Peter van Rensch, Mat Collins, Gabriel Vecchi, Axel Timmermann, et al. 2014. 'Increasing Frequency of Extreme El Niño Events due to Greenhouse Warming', *Nature Climate Change*, 5(1): 1–6. Available at doi:10.1038/nclimate2100.
- Carpenter, Stephen R., William A. Brock, Jonathan J. Cole, and Michael L. Pace. 2013. 'A New Approach for Rapid Detection of Nearby Thresholds in Ecosystem Time Series', *Oikos*, 123(3): 290–7. Available at doi:10.1111/j.1600-0706.2013.00539.x.
- Cheung, William W.L., Vicky W.Y. Lam, Jorge L. Sarmiento, Kelly Kearney, Reg Watson, Dirk Zeller, and Daniel Pauly. 2009. 'Large-Scale Redistribution of Maximum Fisheries Catch Potential in the Global Ocean Under Climate Change', *Global Change Biology*, 16(1): 24–35. Available at doi:10.1111/j.1365-2486.2009.01995.x.
- Descombes, Patrice, Mary S. Wisz, Fabien Leprieur, Valeriano Parravicini, Christian Heine, Steffen M. Olsen, Didier Swingedouw, Michel Kulbicki, David Mouillot, and Loïc Pellissier. 2015. 'Forecasted Coral Reef Decline in Marine Biodiversity Hotspots Under Climate Change', *Global Change Biology*, 21(7): 2479–87. Available at doi:10.1111/gcb.12868.
- Diaz, Robert J. and Rutger Rosenberg. 2008. 'Spreading Dead Zones and Consequences for Marine Ecosystems', *Science*, 321(5891): 926–9. Available at doi:10.1126/science.1156401.
- Dubash, Navroz K. 2016. 'Safeguarding Development and Limiting Vulnerability: India's Stakes in the Paris Agreement', *Wiley Interdisciplinary Reviews: Climate Change*, 8(2): e444–10. Available at doi:10.1002/wcc.444.
- Duvat, Virginie K.E., Alexandre K. Magnan, Russell M. Wise, John E. Hay, Ioan Fazey, Jochen Hinkel, Tim Stojanovic, Hiroya Yamano, and Valérie Ballu. 2017. 'Trajectories of Exposure and Vulnerability of Small Islands to Climate Change', *Wiley Interdisciplinary Reviews: Climate Change*, 8(6): e478–14. Available at doi:10.1002/wcc.478.
- Feagin, Rusty A., Nibedita Mukherjee, Kartik Shanker, Andrew H. Baird, Joshua Cinner, Alexander M. Kerr, Nico Koedam, et al. 2010. 'Shelter from the Storm? Use and Misuse of Coastal Vegetation Bioshields for Managing Natural Disasters', *Conservation Letters*, 3(1): 1–11. Available at doi:10.1111/j.1755-263X.2009.00087.x.
- Ferrari, Maud C.O., Mark I. McCormick, Philip L. Munday, Mark G. Meekan, Danielle L. Dixon, Oona Lönnstedt, and Douglas P. Chivers.

2012. 'Effects of Ocean Acidification on Visual Risk Assessment in Coral Reef Fishes', *Functional Ecology*, 26(3): 553–8. Available at doi:10.1111/j.1365-2435.2011.01951.x.
- Fishery Resources Assessment Division (FRAD). 2017. 'Marine Fish Landings in India 2016', Central Marine Fisheries Research Institute (CMFRI), Kochi.
- Government of Gujarat. 2014. 'State Action Plan on Climate Change', Climate Change Department. Available at <http://moef.gov.in/wp-content/uploads/2017/08/Gujarat-SAPCC.pdf>; accessed on 13 June 2019.
- Government of Tamil Nadu. 2014. 'State Action Plan on Climate Change', available at <http://moef.gov.in/wp-content/uploads/2017/09/Tamilnadu-Final-report.pdf>; accessed on 13 June 2019.
- Hewitt, Judi E., Joanne I. Ellis, and Simon F. Thrush. 2016. 'Multiple Stressors, Nonlinear Effects and the Implications of Climate Change Impacts on Marine Coastal Ecosystems', *Global Change Biology*, 22(8): 2665–75. Available at doi:10.1111/gcb.13176.
- Holbrook, Sally J., Russell J. Schmitt, Thomas C. Adam, and Andrew J. Brooks. 2016. 'Coral Reef Resilience, Tipping Points and the Strength of Herbivory', *Scientific Reports*, 6: 35817. Available at doi:10.1038/srep35817.
- Holling, C.S. 1973. 'Resilience and Stability of Ecological Systems', *Annual Review of Ecology and Systematics*, 4(1): 1–23.
- Holmlund, Cecilia M. and Monica Hammer. 1999. 'Ecosystem Services Generated by Fish Populations', *Ecological Economics*, 29(2): 253–68. Available at doi:10.1016/s0921-8009(99)00015-4.
- Hughes, Terry P., Kristen D. Anderson, Sean R. Connolly, Scott F. Heron, James T. Kerry, Janice M. Lough, Andrew H. Baird, et al. 2018. 'Spatial and Temporal Patterns of Mass Bleaching of Corals in the Anthropocene', *Science*, 359(6371): 80–3. Available at doi:10.1126/science.aan8048.
- Karkarey, R., N. Kelkar, A. Savio Lobo, T. Alcoverro, and R. Arthur. 2014. 'Long-lived Groupers Require Structurally Stable Reefs in the Face of Repeated Climate Change Disturbances', *Coral Reefs*, 33(2): 289–302. Available at doi:10.1007/s00338-013-1117-y.
- Kelman, Ilan, Himani Upadhyay, Andrea C. Simonelli, Alex Arnall, Divya Mohan, G.J. Lingaraj, Shadananan Nair, and Christian Webersik. 2017. 'Here and Now: Perceptions of Indian Ocean Islanders on the Climate Change and Migration Nexus', *Geografiska Annaler, Series B: Human Geography*, 99(3): 284–303. Available at doi:10.1080/04353684.2017.1353888.
- Lundberg, Jakob and Fredrik Moberg. 2003. 'Mobile Link Organisms and Ecosystem Functioning: Implications for Ecosystem Resilience

- and Management', *Ecosystems*, 6(1): 87–98. Available at doi:10.1007/s10021-002-0150-4.
- McCauley, D.J., M.L. Pinsky, S.R. Palumbi, J.A. Estes, F.H. Joyce, and R.R. Warner. 2015. 'Marine Defaunation: Animal Loss in the Global Ocean', *Science*, 347(6219): 1255641. Available at doi:10.1126/science.1255641.
- Moberg, Fredrik and Carl Folke. 1999. 'Ecological Goods and Services of Coral Reef Ecosystems', *Ecological Economics*, 29(2): 215–33.
- Mukherjee, Nibedita, Farid Dahdouh-Guebas, Vena Kapoor, Rohan Arthur, Nico Koedam, Aarthi Sridhar, and Kartik Shanker. 2010. 'From Bathymetry to Bioshields: A Review of Post-Tsunami Ecological Research in India and Its Implications for Policy', *Environmental Management*, 46(3): 329–39. Available at doi:10.1007/s00267-010-9523-1.
- Murakami, Hiroyuki, Gabriel A. Vecchi, and Seth Underwood. 2017. 'Increasing Frequency of Extremely Severe Cyclonic Storms Over the Arabian Sea', *Nature Climate Change* 7(12): 885.
- Nidheesh, A.G., M. Lengaigne, J. Vialard, T. Izumo, A.S. Unnikrishnan, B. Meyssignac, B. Hamlington, and C. de Boyer Montegut. 2017. 'Robustness of Observation-Based Decadal Sea-Level Variability in the Indo-Pacific Ocean', *Geophysical Research Letters*, 44(14): 7391–400. Available at doi:10.1002/2017GL073955.
- Patro, S., P. Krishnan, V. Deepak Samuel, R. Purvaja, and R. Ramesh. 2017. 'Seagrass and Salt Marsh Ecosystems in South Asia: An Overview of Diversity, Distribution, Threats and Conservation Status', in Anjan Kumar Prusty, Rachna Chandra, and P.A. Azeez (eds), *Wetland Science*, pp. 87–104. New Delhi: Springer India.
- Rothman, Daniel H. 2017. 'Thresholds of Catastrophe in the Earth System', *Science Advances*, 3(9): e1700906. Available at doi:10.1126/sciadv.1700906.
- Roxy, Mathew Koll, Aditi Modi, Raghu Murtugudde, Vinu Valsala, Swapna Panickal, S. Prasanna Kumar, M Ravichandran, Marcello Vichi, and Marina Lévy. 2016. 'A Reduction in Marine Primary Productivity Driven by Rapid Warming Over the Tropical Indian Ocean', *Geophysical Research Letters*, 43(2): 826–33. Available at doi:10.1002/2015gl066979.
- Small, Christopher and Robert J. Nicholls. 2003. 'A Global Analysis of Human Settlement in Coastal Zones', *Journal of Coastal Research*, 19(3): 584–99. Available at doi:10.2307/4299200.
- Snelgrove, Paul V.R. 1999. 'Getting to the Bottom of Marine Biodiversity: Sedimentary Habitats', *BioScience*, 49(2): 129–38. Available at doi:10.2307/1313538.

- Storlazzi, Curt D., Edwin P.L. Elias, and Paul Berkowitz. 2015. 'Many Atolls may be Uninhabitable within Decades due to Climate Change', *Scientific Reports*, 5: 14546. Available at doi:10.1038/srep14546.
- Storlazzi, Curt D., Stephen B. Gingerich, Ap van Dongeren, Olivia M. Cheriton, Peter W. Swarzenski, Ellen Quataert et al. 2018. 'Most Atolls Will Be Uninhabitable by the Mid-21st Century because of Sea-Level Rise Exacerbating Wave-Driven Flooding', *Science Advances*, 4(4): eaap9741. Available at doi:10.1126/sciadv.aap9741.
- Sudha Rani, N.N.V., A.N.V. Satyanarayana, and P.K. Bhaskaran. 2015. 'Coastal Vulnerability Assessment Studies Over India: A Review', *Natural Hazards*, 77(1): 405–28. Available at doi:10.1007/s11069-015-1597-x.
- Swapna, P., J. Jyoti, R. Krishnan, N. Sandeep, and S.M. Griffies. 2017. 'Multidecadal Weakening of Indian Summer Monsoon Circulation Induces an Increasing Northern Indian Ocean Sea-Level'. *Geophysical Research Letters*, 44(20): 10–560. Available at doi:10.1002/2017GL074706.
- Thrush, Simon F., Judi E. Hewitt, Paul K. Dayton, Giovanni Coco, Andrew M. Lohrer, Alf Norkko, Joanna Norkko, and Mariachiara Chiantore. 2009. 'Forecasting the Limits of Resilience: Integrating Empirical Research with Theory', *Proceedings of the Royal Society of London, Series B: Biological Sciences*, 276(1671): 3209–17. Available at doi:10.1098/rspb.2009.0661.
- Unnikrishnan, A.S. and D. Shankar. 2007. 'Are Sea-Level-Rise Trends along the Coasts of the North Indian Ocean Consistent with Global Estimates?', *Global and Planetary Change*, 57(3–4): 301–7.
- van Hooidonk, Ruben, Jeffrey Maynard, Jerker Tamelander, Jamison Gove, Gabby Ahmadia, Laurie Raymundo, Gareth Williams, Scott F Heron, and Serge Planes. 2016. 'Local-scale Projections of Coral Reef Futures and Implications of the Paris Agreement', *Scientific Reports*, 6: 1–8. Available at doi:10.1038/srep39666.
- Vergés, A., P.D. Steinberg, M.E. Hay, A.G.B. Poore, A.H. Campbell, E. Ballesteros, K.L. Heck et al. 2014. 'The Tropicalization of Temperate Marine Ecosystems: Climate-Mediated Changes in Herbivory and Community Phase Shifts', *Proceedings of the Royal Society of London, Series B: Biological Sciences*, 281(1789): 20140846. Available at doi:10.1126/science.1063699.
- Walbridge, S., C.V. Kappel, F. Micheli, C. D'agrosa, John F. Bruno, C. Ebert et al. 2008. 'A Global Map of Human Impact on Marine Ecosystems', *Science*, 319(5865): 948–52. Available at doi:10.1126/science.1149345.

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