



CLIMATE CHANGE AND INDIA

ANALYSIS OF POLITICAL ECONOMY AND IMPACT

**ROSA
LUXEMBURG
STIFTUNG
SOUTH ASIA**

**Soumya Dutta
Soumitra Ghosh
Shankar Gopalakrishnan
C.R. Bijoy
Hadida Yasmin**

Rosa Luxemburg Stiftung

The Rosa Luxemburg Stiftung (RLS) is a Germany-based foundation working in South Asia as in other parts of the world on the subjects of critical social analysis and civic education. It promotes a sovereign, socialist, secular and democratic social order, and aims to present alternative approaches to society and decision-makers. Research organisations, groups for self-emancipation and social activists are supported in their initiatives to develop models which have the potential to deliver greater social and economic justice.



Rosa Luxemburg Stiftung—South Asia

Centre for International Co-Operation

C-15, 2nd Floor, Safdarjung Development Area (Market)

New Delhi 110 016, INDIA

Tel.: +91 (0) 11 49 20 46 00 | 49 20 46 40 (D) | Fax : +91 (0) 11 49 20 46 66

Daanish Books

At Daanish Books our focus is on publishing and distributing books that can be vehicle of social transformation. Our working philosophy is “from the people, to the people.”

At Daanish Books we intend

- To represent the most incisive writing on the increasingly complex and challenging contemporary situations;
- To develop series of books and pamphlets in local languages which can be of help to individuals and groups working at the grassroots;
- To act as a bridge between the worlds of theory and practice and between academics and activism;
- To initiate and strengthen the process of dialogue both across cultural and social divides and between diverse political/ideological streams—socialist, liberal, Gandhian, nationalist, and the radical Left.

Daanish Books also has plans of extending this engagement to the entire subcontinent, to the emerging new thinking elsewhere in Asia, Africa, Latin America and the Islamic world, and into the search for alternatives in both Europe and the former socialist world, each of which is facing serious crises of both survival and identity.

Our current focus areas are:

- Globalization and Structural Adjustment
- Militarization and Nuclearization
- Ecology and the Environment
- Identity, Pluralism and the Threat to Diversity
- Alternative Visions of the Future

CLIMATE CHANGE AND INDIA

ANALYSIS OF POLITICAL ECONOMY AND IMPACT

Soumya Dutta
Soumitra Ghosh
Shankar Gopalakrishnan
C.R. Bijoy
Hadida Yasmin



© Rosa Luxemburg Stiftung—South Asia, 2013
Centre for International Co-Operation | C-15, 2nd Floor,
Safdarjung Development Area (Market), New Delhi 110 016, INDIA
Tel.: +91 (0) 11 49 20 46 00 | 49 20 46 40 (D) | Fax : +91 (0) 11 49 20 46 66

All rights reserved.

No part of this book may be reproduced, in any form, without written permission from the publisher. Citation is encouraged. Short excerpts may be translated and/or reproduced without prior permission, on the condition that the source is duly acknowledged.

Responsibility for the contents and for the opinions expressed rests solely with the authors.

Climate Change and India: Analysis of Political Economy and Impact was first published in India in 2013

Daanish Books

25 C, Skylark Apartments
Gazipur, Delhi-110 096
Ph.: 011-4306 7412

G-221, Gazipur Village
Gazipur, Delhi-110 096
Ph.: 011-2223 5819

‘Jaishanti’
123, Kautilya Nagar
Patna-800 014, Bihar, India
Tel: +91 95761 85468
E-mail: daanishbooks@gmail.com
Website: www.daanishbooks.com

ISBN 978-93-81144-31-2 (Hb)
ISBN 978-93-81144-32-9 (Pb)

Editorial Assistance: Ishab Mishra
Production Assistance: Akhilesh Choudhary
Cover Design: Pravin Mishra

Published by Dhruva Narayan for Daanish Books
Printed at Printways, Delhi-110092

Contents

<i>Acronyms</i>	<i>xiii</i>
<i>Foreword</i>	<i>xvii</i>
1. The Changes in the World's Climate and their Impacts	1
Hadida Yasmin, Soumya Dutta and Soumitra Ghosh	
1.1 The Physical Phenomenon of Global Warming.....	1
<i>Why Global Warming is Occurring: Disruption in the Carbon</i>	
<i>Flux/Cycle</i>	4
<i>Peaking Emissions</i>	7
<i>Who is Responsible for Global Emissions?</i>	9
<i>The Fallacy of Carbon Space</i>	11
1.2 The Impacts of Global Warming: The Change in Climate	12
<i>Two Sets of Impacts</i>	12
<i>Direct Impacts of Climate Change</i>	13
1.3 India: Unfolding Climate Impacts.....	18
<i>Rise of Sea Level and Inundation of Coastal Areas</i>	18
Increased Soil Salinity	19
Fishing Practices Affected.....	19
Soil Erosion and Inundation	20
<i>Increased Temperatures and Changes in the Rain Cycle</i>	22
Impacts on Crop Productivity.....	22
<i>The Changing Monsoon</i>	25
<i>Floods and Melting of Glaciers</i>	27
<i>Increased Threat of Cyclones</i>	29
<i>Increased Risk of Disease</i>	29
<i>Impacts on Forests</i>	30
1.4 Climate Change and India: Are We Ready to Cope?	33
<i>Notes</i>	34
<i>References</i>	35

2. The Politics of Climate	39
C.R. Bijoy, Soumitra Ghosh and Soumya Dutta	
2.1 The Context.....	39
2.2 The Climate Talks: Speculating With the Future.....	40
<i>The Intergovernmental Panel on Climate Change</i>	41
2.3 UNFCCC: Setting the Terms of Carbon Trade.....	42
<i>Defining the Problem and the Solution</i>	42
<i>The Kyoto Protocol</i>	42
<i>Evolving Global Mechanisms for Carbon Emission</i>	
<i>Reduction and Climate Change Adaptation</i>	44
<i>What Next After Kyoto?</i>	45
<i>What Next After Kyoto? Folding Up For Another Rewrite</i>	48
<i>Towards A Legally Binding Agreement</i>	49
<i>Battle Lines Drawn and Redrawn:</i>	
<i>Geopolitics and Climate Politics</i>	49
<i>Outside the UN Process</i>	50
<i>The World has Moved On</i>	52
2.4 The Climate Talks in Retrospect.....	53
<i>Whither Climate Change Response:</i>	
<i>The Grotesque Reality of Carbon Trading</i>	54
2.5 India and the UNFCC.....	57
<i>The Argument for Carbon Equity</i>	57
<i>Equity That Is Fundamentally Inequitable</i>	59
<i>Profiting from Kyoto</i>	61
<i>India's Climate Politics: Need for a Re-look</i>	62
Notes	64
References	75
3. India's Energy Sector: A Critical Re-Look	79
Shankar Gopalakrishnan and Soumya Dutta	
3.1 Character of India's Energy Sector and Trends of Change.....	80
<i>Coal</i>	81
The Question of Efficiency.....	82
Impacts of Coal Use: Coal Mining.....	83
Impacts of Coal Use: Coal-Fired Power Plants.....	85
<i>Hydroelectricity</i>	87
Impacts of Hydroelectricity Production	88
<i>Impact in the Northeast</i>	90
<i>Nuclear Power</i>	91
<i>Natural Gas</i>	96
<i>Renewables (Other than Large Hydroelectric Projects)</i>	97

Wind Energy.....	98
Biomass Energy	100
Small Hydroelectricity Projects.....	101
Solar Energy.....	102
The Government's Trading Initiative.....	103
3.2 The Question of Energy Demand.....	104
<i>Industrial Demand.....</i>	<i>105</i>
<i>Residential Demand.....</i>	<i>108</i>
3.3 Economic Policies, Energy Infrastructure and Ways Forward .	110
Notes.....	111
References.....	111
4. Mitigating Climate Change: The Indian way.....	115
Soumitra Ghosh	
4.1 What is Mitigation?.....	115
<i>Development but No GHG Mitigation: The NAPCC</i>	<i>117</i>
Hollow Claims about Mitigation	118
<i>Energy Efficiency Mission: Making a Case for CDM.....</i>	<i>119</i>
<i>Other Missions: Biofuel and Biotechnology</i>	<i>121</i>
<i>Carbon Trading in India: The Clean Development</i>	
<i>Mechanism (CDM) and</i>	
<i>Renewable Energy Trading (RET)</i>	<i>122</i>
<i>CDM in India: Mitigation at a Domestic Level?</i>	<i>122</i>
<i>The Reality of Indian CDM: Examining the Myth of</i>	
<i>Sustainable Development</i>	<i>124</i>
4.2 Defining and Assessing Sustainable Development.....	125
<i>The New UNFCCC Study</i>	<i>125</i>
<i>Utterly False Claims of Sustainable Development</i>	<i>129</i>
4.3 Emissions Reduction through CDM in India:	
Non-Additional, Fraudulent Projects	132
<i>The Fraud in Indian CDM Proved: The Wikileaks Revelation..</i>	<i>133</i>
4.4 Free Market Carbon Trading in India: The Trade in RECs.....	135
<i>REC Trading Picks Up</i>	<i>137</i>
4.5 Mitigating Climate Change through India's Forests:	
Green India Mission (GIM) and REDD+	139
<i>GIM and REDD+: A Note titled India and REDD+ from the</i>	
<i>Ministry of Environment and Forests, 2010.....</i>	<i>141</i>
<i>Analysis of a Country Submission by the Ministry of Environment</i>	
<i>and Forests, 2011</i>	<i>143</i>
<i>Summing Up the Indian Government's REDD+ Claims</i>	<i>145</i>
Questioning the Claims: Cooked up Carbon Storage Data? .	146

Questioning the Claims: Evident Emphasis on Carbon Forestry	146
Questioning the Claims: GIM and REDD+ as Attacks on Community Rights.....	147
Questioning the Claims: No Transparency in REDD+	149
4.6 Meaningful Mitigation Action: What Needs to be Done	149
Notes.....	151
References.....	152
5. Adaptation to Climate Change in India: A Bleak Future	155
Soumya Dutta	
5.1. Introduction.....	155
<i>Adaptation Support: The Kyoto Protocol</i>	156
<i>Bali Action Plan 2007</i>	157
<i>Various Facets of Adaptation</i>	158
<i>What the Vulnerable Country Governments Are Doing</i>	160
5.2. Adaptation in India.....	162
5.3. Climate Finance for Adaptation	164
Notes.....	166
References.....	166
6. Conclusions	169
C.R. Bijoy, Hadida Yasmin, Shankar Gopalakrishnan, Soumitra Ghosh and Soumya Dutta	
6.1. Conclusions of the Present Report.....	170
6.2. Suggested Ways Forward.....	173
<i>New Policies on Energy</i>	174
<i>India's Position in the International Arena</i>	176
<i>Adaptation to the Impacts of Climate Change</i>	177
Annexure 1: Black Gold to Black Curse:	
Coal and Coal-Based Thermal Power in India.....	179
Soumya Dutta	
A1.1. Huge Coal Consumption: Massive Pollution and Climate Change.....	180
<i>Coal and Thermal Power</i>	182
A1.2. The Indian Scene	184
A1.3. Disparities, Discrimination and Deception: India's Energy Consumption.....	187
<i>Energy, But Not for the Energy Deprived</i>	192

Huge Land Grab and Displacement—Massive Forest Destruction	196
A1.4. Water, Life, Climate Crisis— Why Coal Must Be Phased Out	200
<i>Phase Out Coal</i>	204
A1.5. Can Renewable Sources Fully Replace Coal and Meet All Future Energy Demand?	205
Notes.....	206
References.....	207
Annexure 2: The Emerging Climate Change Crisis and the Response of the State in India.....	211
Soumya Dutta	
A2.1 Introduction	211
A2.2 Climate Change Policies and Plans in India	213
<i>Domestic Growth Model Contradicts Climate Change Concerns.....</i>	<i>216</i>
<i>Climate Friendly Agriculture Throttled</i>	<i>217</i>
<i>The Water Mission: Making Way for More Disasters.....</i>	<i>221</i>
<i>The Energy Mission: Creating Business Opportunities for Large Corporations</i>	<i>224</i>
<i>Green India Mission: REDD+ by Another Name</i>	<i>226</i>
A2.3 State Action Plans on Climate Change	227
Notes.....	229
References.....	232
Index.....	235

Figures and Tables

FIGURE 1.1:	Combined Global Land and Marine Surface Temperature Record, 1850 to 2011.	3
FIGURE 1.2:	Emissions of Major Greenhouse Gases (Carbon Dioxide, Nitrous Oxide, Methane and Chlorofluorocarbons) from Year 1978 to 2010	5
FIGURE 1.3:	Increase in Carbon Dioxide Emissions from Different Sectors (in millions of metric tonnes)	9
FIGURE 1.4:	World Carbon Emissions (in billions of metric tonnes)	10
FIGURE 1.5:	NASA Satellite Image showing Loss of Arctic Summer Ice Cover over the Last 30 Years.	16
FIGURE 1.6:	Annual Cycles of All India Mean Rainfall (bars) and Surface Air Temperature (lines) Simulated by PRECIS for the 1970s, the 2020s, the 2050s and the 2080s.....	26
FIGURE 1.7:	Frequency Distribution of Cyclones in the Bay of Bengal	29
FIGURE 1.8:	Ecoregions of the Eastern Himalayas and Their Relative Vulnerability to Climate Change	32
FIGURE 5.1:	National Water Footprints	164
FIGURE A1.1:	World Coal Production by Region, 1980–2010	181
FIGURE A1.2:	Global Coal Reserves	183
FIGURE A1.3:	Total Energy Consumption in India.....	185
FIGURE A1.4:	Consumption of Coal by Major Sectors of the Indian Economy.....	187
FIGURE A1.5:	Rural-Urban Electricity Consumption Distribution	193
FIGURE A1.6:	Energy Map, Showing Distribution of Coal and Hydro Power Resources.....	194
FIGURE A1.7:	Percentage of Electrified Rural Households	195
FIGURE A1.8:	Major Coalfields in India	196
FIGURE A1.9:	Fossil Fuel Reservoirs and Emissions from 1750–2004.....	205

TABLES

TABLE 4.1:	Assessing Sustainable Development in CDM: UNFCCC Indicators	127
TABLE 5.1:	Recent Estimates of International Climate Finance Needed	165
TABLE A1.1:	Top Ten Hard Coal Producers (2010e).....	182
TABLE A1.2:	Countries Dependent on Coal for Electricity Production	182
TABLE A1.3:	India: Primary Energy Consumption Mix in 2007–08	186
TABLE A1.4:	All India Region-wise Generating Installed Capacity (MW) of Power Utilities.....	188
TABLE A1.5:	Sector-wise Total Installed Capacity.....	189
TABLE A1.6:	Relationship between Income and Energy Consumption (World)	189
TABLE A1.7:	Relationship between Income and Energy Consumption (India)	189
TABLE A1.8:	Per Capita Consumption of Major Commercial Energy by Source	190
TABLE A1.9:	Displacement Caused by Land Acquisition (As declared by Mining Companies).....	198
TABLE A1.10:	Coal Mining and Environment Clearance during 11th FYP (2007–11).....	199
TABLE A1.11:	Coal Ash Radioactivity.....	202
TABLE A1.12:	Industry-wise Allocation of Water per Annum.....	203

Acronyms

A&R—Afforestation and Reforestation	CFL—Compact Fluorescent Lamp
ADB—Asian Development Bank	CFM—Community Forest Management
ALBA—Bolivarian Alliance for the Peoples of Our America	CGES—Centre for Global Energy Studies
AOSIS—Alliance of Small Island Nation	CIA—Central Intelligence Agency
AR4—Fourth Assessment Report of IPCC	CMP—Meeting of the Parties
BASIC—Brazil, South Africa, India and China	CMPDI—Central Mine Planning & Design Institute Limited
BIC—Bank Information Center	CNG—Compressed Natural Gas
BoP—Base of the Pyramid	CoPs—Conference of Parties
CBD—Convention on Biological Diversity	CPPCIF—Change Planet Partners Climate Innovation Foundation
CBDR—Common But Differentiated Responsibilities	CSE—Centre for Science and Environment
CDM—Clean Development Mechanism	CSO—Central Statistics Office
CEIWEP—Committee on Environmental Impacts of Wind Energy Projects	CTL—Coal-to-Liquid
CERC—Central Electricity Regulation Commission	CTW—Carbon Trade Watch
CERs—Certified Emissions Reduction credits	CWC—Central Water Commission
CFCs—Chlorofluorocarbons	DFID—Department for International Development
	DISHA—Direct Initiative for Social Health Action
	DNV—Det Norske Veritas
	DOEs—Designated Operational Entities

DTR—Diurnal Temperature Range	GIZ—German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
EDF—Environmental Defense Fund	
EIA—Environment Impact Assessment	
EMP—Environment Management Plans	GLOFs—Glacial Lake Outburst Floods
EPA—U.S. Environment Protection Agency	GM—Genetically Modified
EREC—European Renewable Energy Council	GNP—Gross National Product
ERUs—Emission Reduction Units	GoD—Government of Delhi
ESP—Electrostatic Precipitator	GoI—Government of India
EU—European Union	GRACE—Gravity Recovery and Climate Experiment
EUA—EU Emission Allowance	GSI—Geological Survey of India
EU-ETS—European Union-Emissions Trading Scheme	GTZ—German Technical Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit)
FDI—Foreign Direct Investment	HELE—High-Efficiency, Low- Emissions
FICCI—Federation of Indian Chamber of Commerce and Industry	HFC—Hydrofluorocarbon
FMNR—Farmer-Managed Natural Regeneration	ICIMOD—International Centre for Integrated Mountain Development
FRA—Forest Rights Act	IEA—International Energy Agency.
FSI—Forest Survey of India	IEP—International Electric Power
FY—Financial Year	IEX—Indian Energy Exchange
GAIN—Global Agricultural Information Network	IGES—Institute for Global Environmental Strategies
GAO—Governmental Accountability Office	IITM—Indian Institute of Tropical Meteorology
GDP—Gross Domestic Product	IMD—India Meteorological Department
GEF—Global Environment Facility	INCCA—Indian Network for Climate Change Assessment
GENI—Global Energy Network Institute	IPCC—Intergovernmental Panel on Climate Change
GHGs—Greenhouse Gases	IPR—Intellectual Property Rights
GIM—Green India Mission	
GISS—Goddard Institute of Space Studies	

IRGSSA—International Resources Group Systems South Asia Private Limited	NESPO—North Eastern Society for Protection of Nature and Wild Life
ISAAA—International Service for the Acquisition of Agri-biotech Applications	NFFPF—National Forum of Forest People and Forest Workers
JFM—Joint Forest Management	NMSA—National Mission on Sustainable Agriculture
JFMC—Joint Forest Management Committees	NOAA—National Oceanic and Atmospheric Administration
JI—Joint Implementation	NPCIL—Nuclear Power Corporation of India
JNNSM—Jawaharlal Nehru National Solar Mission	NPP—Net Primary Productivity
JSW—Jindal South West factory	NRC—Nuclear Regulatory Commission
LDCs—Least Developed Countries	NRDC—Natural Resources Defense Council
LEED—Leadership in Energy and Environmental Design	NTFP—Non-Timber Forest Produce
LULUCF—Land Use, Land-Use Change, and Forestry	NWM—National Water Mission
MEF—Major Economies Forum	ODS—Ozone Depleting Substances
MoEF—Ministry of Environment and Forests	ORNL—Oak Ridge National Laboratory
MoP—Ministry of Power	PACS—Poorest Areas Civil Society
MTPA—Million Tonnes Per Annum	PAT—Perform Achieve and Trade
NAP—National Afforestation Programme	PDDs—Project Design Documents
NAPCC—National Action Plan for Climate Change	PFBR—Prototype Fast Breeder Reactor
NASA—National Aeronautics and Space Administration	PFCs—Perfluorocarbons
NCAP—National Carbonaceous Aerosol Programme	PPP—Purchasing Power Parity/ Public-Private Partnership
NCDMA—National CDM Authority	PRECIS—Providing Regional Climates for Impact Studies
NCEUS—National Commission for Enterprises in Unorganized Sector	PTI—Press Trust of India
NCW—National Commission for Women	PV—Photovoltaics
	PXIL—Power Exchange of India Ltd
	QUMP—Quantifying Uncertainty in Model Predictions
	RCM—Regional Climate Model

RE—Renewable Energy	TPPs—Thermal Power Plants
REC—Renewable Energy Certificate	TRU—Transuranic wastes
REDD—Reducing emissions from deforestation and forest degradation	UN—United Nations
RET—Renewable Energy Trading	UNCED—United Nations Conference on Environment and Development
RETCR—Renewable Energy Trading Certificate Registry	UNEP—United Nations Environment Programme
RGVY—Rajiv Gandhi Grameen Vidyutikaran Yojana	UNESCO—United Nations Educational, Scientific and Cultural Organization
RPO—Renewable Purchase Obligation	UNFCCC—United Nations Framework Convention on Climate Change
SANDRP—South Asia Network of Dams, Rivers and People	UN-OCHA—United Nations Office of Coordination of Humanitarian Affairs
SAPCCs—State Action Plans on Climate Change	USCAP—The U.S. Climate Action Partnership
SERC—State Electricity Regulatory Commissions	USDA—U.S. Department of Agriculture
SFDs—State Forest Departments	USSR—Union of Soviet Socialist Republics
SME—Small and Medium Enterprises	WCA—World Coal Institute
SMF—Sustainable Management of Forest	WEGs—Wind Energy Generators
SOPAC—South Pacific Applied Geoscience Commission	WISE—World Institute of Sustainable Energy
SOR—Statement of Reasons	WRI—World Resources Institute
SWAT—Soil and Water Assessment Tool	WWF—World Wildlife Fund
TERI—The Energy Research Institute	

Foreword

December 2009... Bella Centre... the temperature inside the centre was warmer than outside but the 'climate' inside was 'cool' enough for the scientists and bureaucrats and most of the official negotiators. It was in Copenhagen where I went with much enthusiasm and optimism that there will be a 'consensus' between those who wanted to save the planet and those who wanted to sustain the 'civilization'—the capitalist civilization. Many of us know the outcome of the 15th Conference of Parties (CoP 15) in Copenhagen all attempts to come up with, as Eric Swyngedouw says, 'consensually-established and negotiated solution' failed to give way to the 'Accord.' Soumya Dutta, one of the authors of this book, and I were together trying to collect and document all relevant information for our fellow colleagues back in India. That was my first real encounter with the issue of climate change.

In mid 2011, John Neelsen (Professor of Sociology in Tuebingen University, Germany), Carsten Krinn and I, in the valleys of Nepal, were trying to sketch out some of the thematic areas of RLS intervention in South Asia. We were arguing that most important is to have proper political foundations for our demands, whether it is a matter of social justice or climate justice. That was the time when C.R. Bijoy and Shankar Gopalakrishnan from Campaign for Survival and Dignity helped us in giving a concrete shape to our thoughts while suggesting us to develop a perspective paper for the left actors especially in India.

A few months later, as a member of strategy planning retreat of RLS South Asia in Bangalore, I was arguing how 'climate change' and

funds attached to it is changing the nature of NGOs/CSOs in India and South Asia. How there is hardly any political dimension to the environmental arguments which in the case of climate change is very much confined to the methods of handling CO₂ emissions. And there is a need to shift the focus from CO₂ per se to the political-social debates. At RLS South Asia, we believe that climate change has to be located within the broader perspective of the social and political rather than the narrow limits of environmental.

We were more eager than ever to come up with a text which highlights the social and political in the arena of climate change. Thanks to Soumitra Ghosh who facilitated the co-ordination among the working group members with Hadida Yasmin as its fifth member. Hadida along with Soumya and Soumitra were closely monitoring the developments in the field of Clean Development Mechanism in India.

The '*Climate Change and India: Analysis of Political Economy and Impact*' is primarily beneficial for those who want to approach this issue from a people's perspective. The book attempts to bring together the overlapping processes of globalization, global warming and the politics of development. While unfolding the international climate politics on the one hand, the book also tries to look at the political economy of the largest carbon emitting sector in India from close corners. The book not only critically examines the effective lack on the part of the developed countries to reorient their policies, pay reparations; but also demonstrates that while pursuing a policy of denial/refusal, a highly questionable 'solution' to the global threat is envisaged which is totally in line with new *market-based opportunities*. It is an endeavour of ours in our quest to deal with some of the open questions we encounter in our social and political life. The views and opinions expressed in this book are those of the authors and do not necessarily reflect the official position of RLS South Asia. We hope to have meaningful engagements with you in this regard.

Vinod Koshti

Project Manager, South Asia (Agrarian Questions)

1

The Changes in the World's Climate and their Impacts

Hadida Yasmin, Soumya Dutta and Soumitra Ghosh

1.1 The Physical Phenomenon of Global Warming

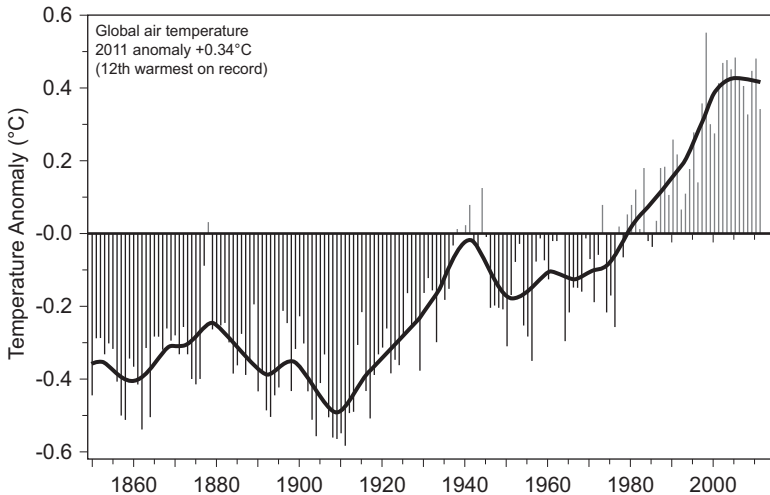
The all-pervasive impact of the changing climate is probably the greatest challenge that humanity faces in the 21st century. Though earth's climate has always been variable over long time-scales of thousands of years, the pace and magnitude of the changes witnessed in recent times seems to be unprecedented. The biggest contributor to the life-threatening changes in natural ecosystems and natural cycles is the huge amount of fossil carbon fuels (coal, petroleum and natural gas) that richer sections of the industrial human society have extracted and burned—especially in the last 150 years. Other activities of the industrial societies, such as expansion and intensification of ecologically destructive land uses in commercial interest, rapidly rising pollution levels, introduction of exotic species and over-harvesting of biological and non-renewable resources also contributed directly to the changing global climate. This has affected all life systems on the earth and, among other consequences, has dangerously accelerating the extinction rate of species.

These activities resulted in sending far more greenhouse gases (such as carbon dioxide, methane and nitrous oxide) to the planet's atmosphere than existed earlier. This has led, in turn, to a 'greenhouse' like situation which allows, on the one hand, higher energy radiation of the sun to come through, but on the other, traps the low-energy heat the earth radiates back, leading the earth's surface to become continually warmer. Additional carbon dioxide and other greenhouse gases in the atmosphere create a veritable dome like shield that prevents the heat from diffusing out into space; hence the analogy with a warming greenhouse. Several periods of warming earlier in the century had been recognized by climatologists, but the current major warming only became evident to a wider audience from the 1980s, and the warming trend has continued into the 21st century. According to the assessment report of Intergovernmental Panel on Climate Change (IPCC-AR4), since 1850, the warmest recorded years so far have been 1998 and 2005, with 2002 to 2004 being the 3rd, 4th and 5th in the series.

The present annual global average (or mean) temperature has risen to about 14.5°C from around 13.7°C a hundred years ago, but annual average temperatures are not always the best indicators of a trend: many short-lived weather phenomena might be responsible for the change in weather (El Nino years tend to be warmer, La Nina¹ years are generally cooler, large volcanic eruptions may cool down temperatures for a few years, and so on). Taking averages over a longer period, however, confirms the pattern. Thus, according to the UK Meteorological Office, the global average temperature has been rising by about 0.15°C every decade (Jones 2012).

Figure 1.1 shows that the period of 2001–2010 was 0.20°C warmer than the 1991–2000 decade (which in turn was 0.24°C above 1961–90, while the period 2001–2010 was 0.44°C above the 1961–90 mean). The warmest year of the entire series was 1998, with a temperature of 0.55°C above the 1961–90 mean. After 1998, the next nine warmest years in the series are all in the decade 2001–2010, except 2008; and even though 2008 was the coldest year of the 21st century, it was still the 13th warmest year on record.

FIGURE 1.1: Combined Global Land and Marine
Surface Temperature Record, 1850 to 2011



Source: This time series was jointly compiled by the Climatic Research Unit and the UK Meteorological Office Hadley Centre.

The research findings of one of the world's leading climatologists, James Hansen (director of the Goddard Institute of Space Studies in the United States), suggest that the 12-month running mean global temperature reached a new record height in 2010 (Hansen et al. 2010: 1–37). The new record temperature in 2010 is particularly meaningful because it occurred even when the sun had remained unusually inactive and 'cool,' as well as in a year featuring the presence of a relatively well developed La Nina, which contributes to global cooling.

While it may not be responsible for every climatic change that occurs, the warming of the earth's surface can be clearly linked to a large number of such changes. Widespread reduction in the number of frost days in mid-latitude regions, increase in the number of warm extremes and reduction in the number of daily cold extremes have also been observed; the most marked changes being visible with respect to cold nights, which became rarer over the 1951 to 2003 period. Warm nights became more frequent. The diurnal temperature

range (DTR) decreased by 0.07°C per decade on an average over 1950 to 2004 (IPCC-AR4).

Why does global warming happen? What are its main, specific impacts on the earth's climate? As with the extent and scale of global warming itself, the answers to these questions are also somewhat controversial; however, going by the IPCC Report and collating that with a range of other scientific findings, certain facts emerge.

Why Global Warming is Occurring: Disruption in the Carbon Flux/Cycle

According to the IPCC-AR4, emission of three major green house gases (carbon-dioxide, methane and nitrous oxide) since circa 1750 have had a greater cumulative effect on the atmosphere than the aggregate—including both anthropogenic and non-anthropogenic—emissions of the last 10,000 years. Between 1995 and 2005 the level of carbon dioxide alone increased by 20 percent, in spite of the Kyoto Protocol, which required emission reductions by the industrialized countries.

The figure above shows the rise of these three GHGs and another—the very powerful chlorofluorocarbons (CFCs, used in refrigeration, foam making, etc.)—over the last three decades. The industrial activities of richer societies as well as large-scale industrialized agriculture (utilizing lots of synthetic nitrogenous fertilizers) generate all these gases. Methane in significant quantities also comes from livestock, and in a much smaller quantity from flood irrigated rice fields.

Here, it also needs to be noted that greenhouse gases occur naturally as well. One of the naturally occurring GHGs—water vapour—contributes to over 50 percent of the total warming that the earth experiences, and that this creates a stable and liveable climate for all life-forms on earth. Natural cycles (like the carbon cycle, hydrological cycle, nitrogen cycle) control all naturally occurring GHG-concentrations, and without the presence of some GHGs in the atmosphere, the earth will be cold enough to be unsuitable for most life as we know.

However, the extra GHGs that human societies have been emitting in the last 200 odd years have changed this stable climate, without leaving

FIGURE 1.2: Emissions of Major Greenhouse Gases (Carbon Dioxide, Nitrous Oxide, Methane and Chlorofluorocarbons) from Year 1978 to 2010

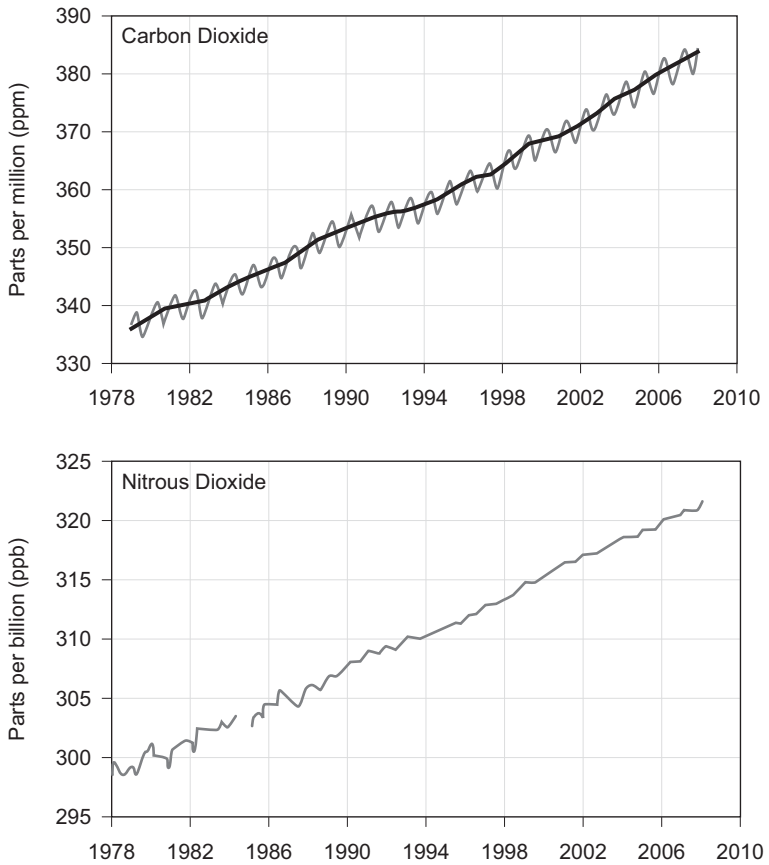
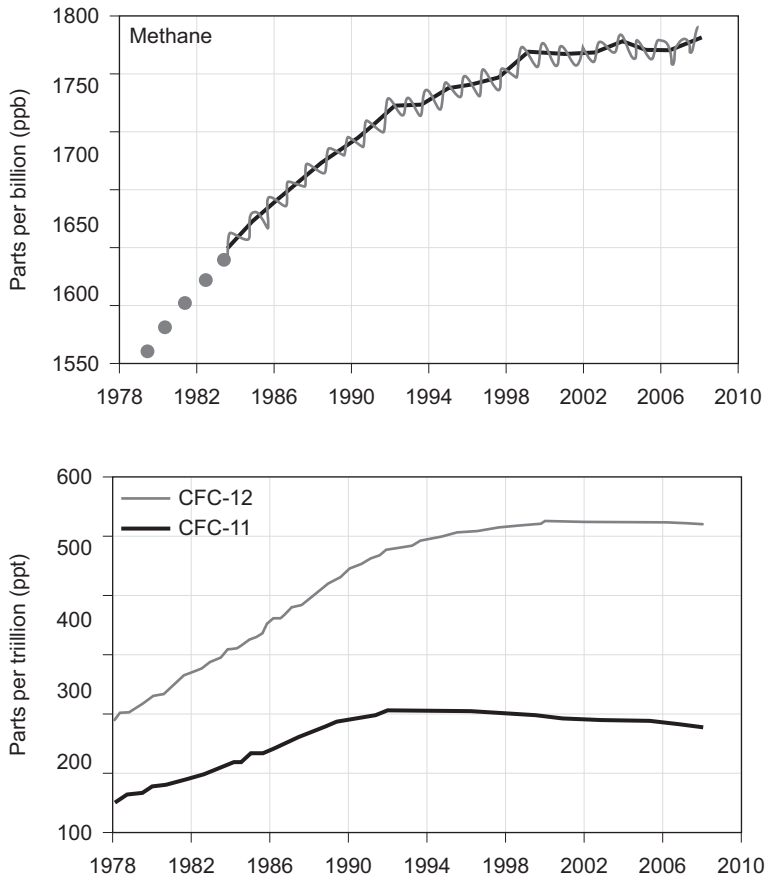


Figure continued on next page...

FIGURE 1.2: Continued...



enough time for the slow-adapting life forms to adjust to new climatic patterns. The real problem is the unabated increase in GHG emissions by the increasingly over-consuming and industrializing human societies (and not Indian cattle and South Asian rice fields, as one of the many popular myths about climate change wants us to believe).

The earth has a natural carbon cycle, whereby many natural activities emit carbon dioxide (carbon-dioxide sources) and at the same time many other natural activities remove it from the atmosphere. Natural spaces that store the removed carbon are known as carbon dioxide-sinks; the atmosphere, the hydrosphere, soil and plants all hold large amounts of carbon or carbon dioxide stocks. The net annual atmospheric carbon dioxide removal capacity of the earth has been estimated at approximately 15–18 Giga Tonnes (GT) per year; this varies, depending on many conditions. In comparison, the annual global anthropogenic (human origin) emission of carbon dioxide increased to about 38 GT by 2010; 2010 emissions from fossil fuel burning alone reached 30.6 GT (Solomon et al. 2007).² On the other hand, the total absorption or sink capacity decreased due to reasons like deforestation and warming of the oceans.

The extra carbon dioxide that the natural carbon cycle of the earth could not remove now builds up in the atmosphere, its concentration increasing by about two parts per million (ppm) each year. From the pre-industrial atmospheric carbon dioxide concentration of about 280 ppm, we reached about 390 ppm in 2010. This is equivalent to about 780 GT of carbon dioxide, compared to roughly about 560 GT in pre-industrial years. The main driver for about 55 percent of global warming is this large additional carbon dioxide, while the rest comes from other GHGs (Keeling 1992).

Peaking Emissions

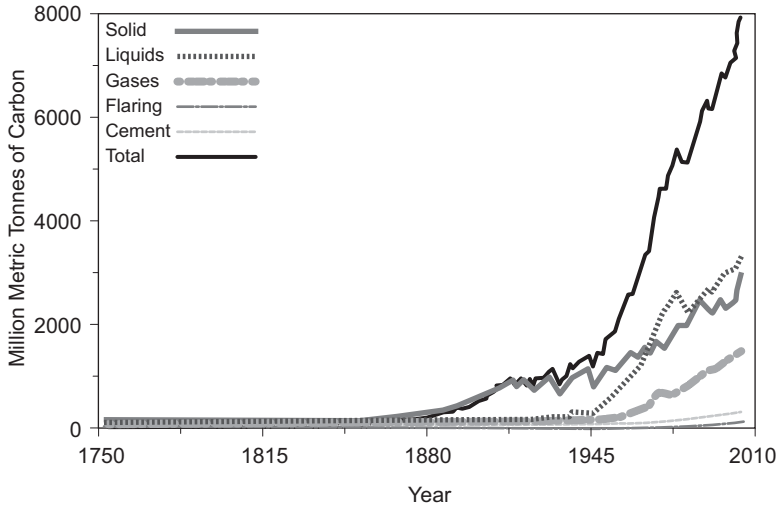
The IPCC-AR4 estimates that to limit the rise in global annual average temperature to 2°C—the limit for triggering catastrophic climate change—atmospheric carbon dioxide concentration has to be limited to 450 ppm, but this estimate is largely based on dated research

and conservative projections. More recent simulation studies by James Hansen's group at GISS brought this down to 350 ppm (Hansen et al. 2010), but current levels are already at around 390 ppm. According to the IPCC: 'Even if emissions peak in 2015 and decrease rapidly at around 3% every year after that, there may only be a 50:50 chance of keeping global temperature rise below 2°C. Every delay of ten years in the peak emissions could add about 0.5°C of warming.' Moreover, the GHGs emitted today will achieve their full warming only in the decades to come. Thus, the warming we see today is the result of emissions made decades ago plus those in the recent past. This time-lag means we already have a built-in warming process on top of the approximately 0.8°C average already recorded; even if magically all additional emissions were to stop tomorrow, the damage from earlier emissions would continue. This makes it even more imperative to reach peak emissions at the earliest, and then to drastically reduce emissions.

The rapidly increasing emissions of carbon come largely from the burning of fossil fuels, as shown in Figure 1.3, where the black line indicates total anthropogenic emission of carbon,³ and the shaded/dotted lines indicate different fuels and industrial sources. Carbon dioxide is a major byproduct of cars, electricity production through burning of coal, natural gas or oil, burning of fuel oil by aircraft and ships, use of fossil fuels in factories and even when one cooks. Nearly 82 percent of the total primary energy of the world came from carbon-based fossil fuels—coal, petroleum and natural gas—in 2010 (Solomon et al. 2007).

Aside from anthropogenic emissions originating from fossil fuels, there is also the dangerous and very real possibility of the world's soils—which hold roughly twice as much carbon dioxide as the entire atmosphere—emitting more carbon as a result of global warming. Warming of soils leads to faster decay of soil organic carbon, greatly increasing the chances of the trapped carbon being released. One needs to also remember that the oceans hold a far larger amount of carbon: anywhere between 40–60 times more than the amount held in the atmosphere.

FIGURE 1.3: Increase in Carbon Dioxide Emissions from Different Sectors
(in millions of metric tonnes)

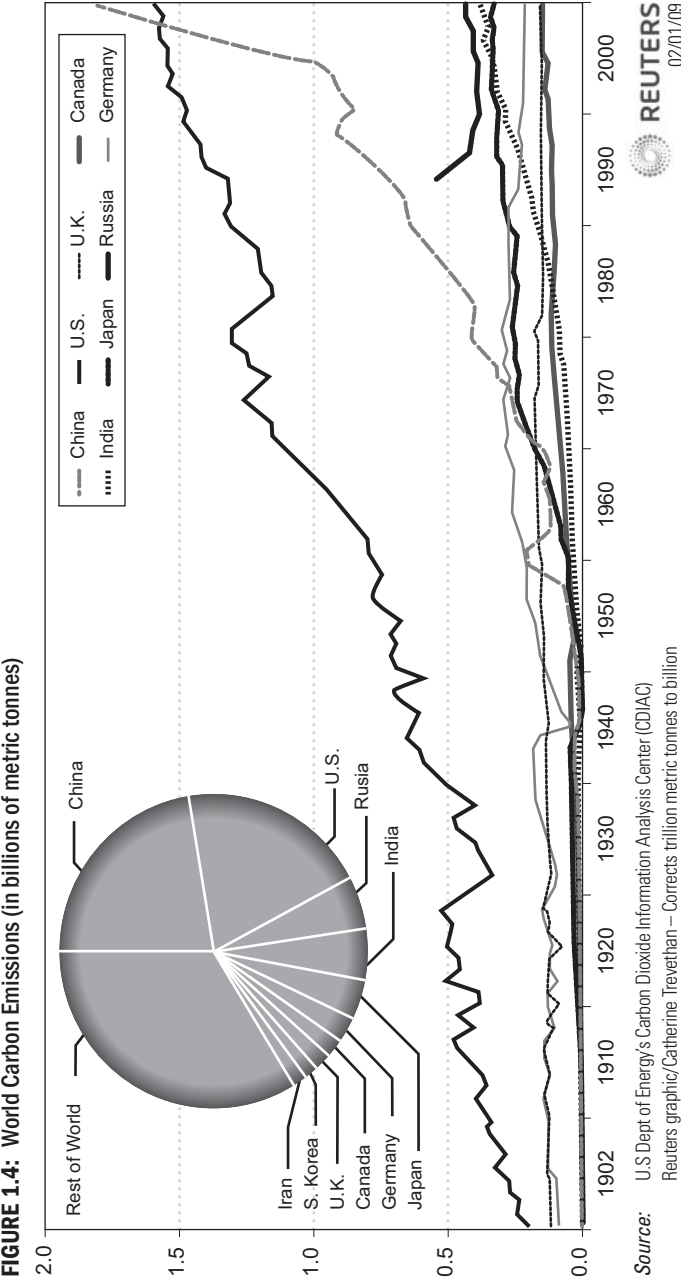


Source: <http://www.forbes.com/sites/williampentland/2011/08/18/u-s-carbon-emissions-exploded-in-2010-largest-single-year-rise-in-22-years/>

Who is Responsible for Global Emissions?

It is not as if the whole of humanity is equally responsible for emissions. A major part of human society—agrarian communities, forest dwellers, artisans, urban poor/slum dwellers—are low energy users and contribute little to the rising emission curve, whereas a small minority in the industrially developed societies, as well as the high consumers in both the global North and South, are responsible for an overwhelming amount of emissions, as shown in Figure 1.4.

The USA with its 300 million odd people, emits the same amount of GHGs as China, which has a population of over 1300 million, and about four times more than India, with its population of over 1200 million (thus, U.S. per capita emissions are 15–16 times higher than Indian per capita emissions), largely poor under-consumers (Figure 1.4). Both Russia and Japan, countries with less than one-eighth of India's population, emit roughly the same



amount of greenhouse gases as India. Most of Least Developed Countries (LDCs) and other poorer countries have even smaller carbon-footprints on a per capita basis, while they pay the greatest price: the hazards of an erratic climate hit them hardest.

The Fallacy of Carbon Space

The entire process of climate dialogues in the official circles does not wish to accept the political economy of climate embodied in this fundamentally and historically unjust use, as well as the present day division of what is now called the global carbon space. Simply speaking, carbon space is the amount of carbon that the natural carbon dumps—a carbon dump is a place that naturally stores carbon, for instance oceans, soil and atmosphere—of the world can store. The rich and industrially developed countries cannot claim any inalienable right over that space, simply because they historically have used the lion's share of it, by burning more fossil fuel in building up and sustaining their energy-intensive industrial practices and lifestyles. The problem is that emissions are increasingly being claimed as a right by the rich and emerging economies alike, even when global warming induced climate change has turned into a full blown crisis and it has been scientifically proved that continued and increased emissions will only aggravate the crisis. Unless this fundamental problem is addressed squarely, no amount of techno-fixes will work in favour of the vulnerable societies who constitute the bulk of climate change victims. In the recent past, official climate negotiations under United Nations Framework Convention on Climate Change (UNFCCC) and the Conference of Parties (CoPs), moved away from addressing this injustice. In fact, the international climate negotiations process has so far been successful only in extending the unjust stranglehold of the rich countries over the last true wilderness and commons left on the earth—the atmosphere. While this process is discussed in greater detail in the next chapter, here we take a look at what this unequal and unsustainable

use of carbon space means for a nation like India and its people, in terms of actual climate change impacts. This section is brief, as climate change impacts on a global scale have already been studied and discussed in detail in the available literature.

1.2 The Impacts of Global Warming: The Change in Climate

Two Sets of Impacts

The present-day global warming and related climatic changes are causing a range of adverse impacts on both the earth's ecosystems and on the bio-sphere, including human societies. There are two different sets of 'impacts' that we face today. The first consists of the actual physical changes in the earth's climate systems primarily due to global warming: irregular rainfall, stronger storms, recurring droughts, heat-waves, huge forest fires, species extinction, unusual cold-waves, loss of agricultural productivity and extreme events.

The second set of impacts originates from actions that our governments and corporate/industrial bodies undertake in the name of mitigating climate change. This includes large-scale agro-fuel and energy plantations in the name of green fuel (to replace petroleum-based fuels), extremely risky genetically modified plants (in the name of both mitigation and adaptation to climate change), more big dams for 'carbon-free' electricity and (in the name of using marginally less energy-intensive industrial practices) actual encouragement of heavily polluting industries such as steel production, coal-fired thermal power plants and nuclear power plants. As a result, poor and marginalized communities in the developing countries often suffer more from such climate change mitigation schemes than from the impacts of actual physical changes in the climate. In the next chapters we will see how both the existing as well as new low-carbon 'alternative' energy practices affect the Indian poor, and often victimize them further.

Direct Impacts of Climate Change

According to the Biodiversity and Climate Change document of the UN Convention on Biological Diversity, several cataclysmic natural changes took place during the 20th century:

- Global mean sea level rose by 10 to 20 cm (the present rate of rise has reached almost 3 mm per year now—NOAA),
- The overall volume of glaciers in Switzerland decreased by two-third,
- Arctic ice thickness in late summer and early autumn decreased by about 40 percent, and
- Mount Kenya lost 92 percent of its ice mass while Mount Kilimanjaro lost 82 percent.

Other significant observed changes include:

- A 40–60 percent decrease in total available water in the large catchment basins of Niger, Lake Chad and Senegal,
- The retreat of 70 percent of sandy shorelines, and
- A northward movement, by some 100 km, of Alaska's boreal forest line for every one degree rise in temperature.

The recently extinct golden toad and Monteverde harlequin frog have already been labelled as the first victims of climate change.

Moreover, current climate change has already made two communities into refugees. The Lateu settlement, located in the Pacific island chain of Vanuatu and the Shishmaref village, located on a small island in Alaska, were recently relocated—the former to escape rising sea levels, the latter as a result of degrading permafrost—as a result of current and future climate change impacts.

Some further observed and predicted physical changes are:

1. Melting of snow and ice in the large ice covered high latitude areas (Greenland, the Arctic, Antarctica, Patagonia and so on) and high altitude areas (such as the Himalayas, the Tibetan

Plateau, the Alps, the Andes, the Rockies and so on). IPCC projects a reduction of sea ice in the 21st century in both the Arctic and in Antarctica, with a rather large range of model responses. The projected reduction is accelerated in the Arctic, whereas some models project that summer sea ice cover will disappear entirely in the latter part of the 21st century.

Antarctica—the largest ice mass on the earth—acts as a global climate controller, a huge food provider for southern ocean marine life and a giant reflector and cold-store cooling the earth. But all this will change if the dangerous warming of the western Antarctica continues. The collapse of the Larsen B Ice Shelf, an ice area of 3250 square kilometres, was captured in a series of images by NASA's Terra satellite between 31 January and 13 April 2002. Before that, the Larsen A Ice shelf similarly disintegrated in 1995. Further, the entire of western Antarctica is getting dangerously warm, as shown in the following NASA satellite (thermal/infra-red) image. If this continent-size ice mass melts away, sea levels can rise by several meters worldwide, wiping out large inhabited areas.

2. Absorption/dissolution of more and more carbon dioxide in the water bodies, mainly oceans. Roughly about a third of the carbon dioxide released by the burning of fossil fuels currently ends up in oceans, increasing its pH value (reflecting a decrease in its alkalinity or increase in relative acidity). This 'ocean-acidification' plays havoc with many forms of marine life by drastically altering the life-support environment of those species (Turley and Boot 2010). Numerous shelled creatures play a vital role in the marine ecosystem, and coral-reefs (known as the rainforests of the ocean) play a vital role in preserving and nurturing marine biodiversity. Change in the pH value or loss of alkalinity will damage these shell and coral formations, and many marine species might die out as a result of being unable to live in more 'acidic' water, possibly

resulting in mass extinction. It is expected that within a century the surface of the southern ocean will become corrosive to the shells of the tiny snails that form a key link in the marine food chain within this highly productive zone (*Scientific American* 2006).

3. This is being compounded by the warming up of the oceans, as an overwhelming part (over 90 percent) of the heat retained on the earth ends up in the oceans, as the heat absorption capacity of water is far higher than air and the oceans hold a larger mass than the atmosphere

Warmer oceans expand (as a result of thermal expansion), contributing even more to the sea level rise problem. Further, as a result of the water temperature rising, marine animals—particularly corals and fish—suffer or even die out. During the unusually warm year of 2010, large-scale coral die-outs were observed in the Andaman Sea (Buddemier and Fuatin 1993) and in other areas of Indonesian coast, and this was not the first or only such case.

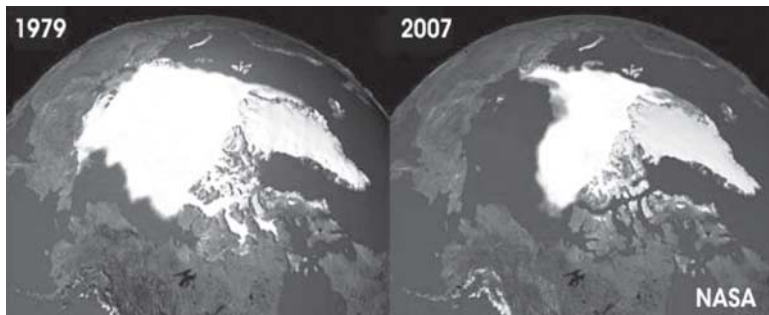
Warmer oceans also absorb lesser amounts of carbon dioxide, thus reducing the carbon dioxide-sink capacity in the earth's carbon cycle (Scheffer et al. 2006). The more the warming, the less the absorption capacity, and less absorption means more carbon dioxide build-up in the atmosphere, leading to more warming and even less absorption. This dangerous circle is called a positive feed-back system, and points to an ever accelerating warming in the near future—leading to a collapse of the system (after crossing what is known as the Tipping Point), unless the carbon dioxide build-up is arrested or reversed soon. Once this stage of self-reinforcing warming is reached, we will face run-away global warming, where human action will become incapable of stopping catastrophic climatic change.

4. The warming oceans are also causing changes in the strength of tropical storms—cyclones, typhoons and hurricanes. These

changes are likely to accentuate, though in a much less predictable manner. IPCC predicts a further increase in strength of these, whereas the change in numbers is uncertain.

5. We face a positive feedback loop not only in the oceans, but also in the world's ice-covered regions. Greater warming melts away more ice cover, exposing water, soil or rock, thus reducing albedo (reflectivity) and increasing solar heat absorption; this in turn melts more snow and ice cover. This has led to a nearly 38 percent loss of the Arctic summer ice cover over the last 30 odd years, as shown in the NASA satellite image reconstruction, and this is expected to accelerate (Figure 1.5).
6. A similar climate-threatening positive feedback loop is also being observed in the permafrost regions, where vast amounts of locked-away carbon dioxide and methane is beginning to be released as the tundra and the Arctic sea-bed are warming. There is more methane locked away (an estimated 1400 GT) in the permafrost than the world's entire coal-carbon stock, and methane is over 22 times as powerful a GHG as carbon dioxide. Scientists are now referring to this as the 'methane time bomb'.
7. Ecosystem damage is another major impact that is already taking hold, and is feared to intensify. For instance, nearly 10,000 square kilometres of Russian forests went up in raging

FIGURE 1.5: NASA Satellite Image showing Loss of Arctic Summer Ice Cover over the Last 30 Years



forest fires (adding huge amounts of carbon dioxide and black carbon aerosols—both contributing to further warming) in the summer of 2010 as a result of unusually dry and warm weather. Large-scale forest fires in Australia, the U.S., Russia, Eastern Europe, Indonesia and other areas are increasing, both in numbers and in the area of forest lost. Elsewhere, unprecedented pest attacks are threatening to wipe out entire forests (UNEP 2010; Cox et al. 2004).⁴

These large-scale physical changes will be accompanied by significant impacts on human beings. These include the following:

1. The health impacts of global warming driven climate change are manifold. From the increase in areas susceptible to vector borne diseases, to the increase of a multitude of bacterial infections, to extreme heat and cold waves (the unusually severe 2003 heat wave in Europe killed over 30,000 people), these often defy coherent compilation and analysis. According to the World Health Organization, 'Health hazards from climate change are diverse, global and difficult to reverse over human time scales. They range from increased risks of extreme weather events to effects on infectious disease dynamics and sea level rise leading to salinization of land and water sources' (Bonita et al. 2006).
2. Agriculture, particularly the low input and rain-fed practices prevalent in many parts of the poorer countries, is being threatened by climate change. This in turn impacts food security. Many countries are experiencing significant changes in rainfall; the UK Meteorological Office says that total summer rainfall has decreased in all parts of UK.

1.3 India: Unfolding Climate Impacts

The IPCC-AR4 indicates that developing countries such as India are likely to be highly vulnerable to climate change, due to both the

projected magnitude of the change and the lack of coping ability. Climate change is likely to have severe impacts on natural ecosystems as well as on traditional socio-economic systems in India, as more than 750 million rural Indians directly depend on climate-sensitive sectors (agriculture, forests, natural resource-based artisanal occupations and fisheries) and natural resources (such as water, biodiversity, mangroves, coastal zones, tropical forests and grasslands) for their subsistence and livelihoods (Thomas et al. 2004).⁵

According to Ministry of Environment and Forests' Indian Network for Climate Change Assessment (INCCA) report of 14 October 2010 (Sharma and Chauhan 2011), energy, industry, agriculture and waste sectors contributed 58 percent, 22 percent, 17 percent and 3 percent of India's net carbon dioxide equivalent emissions respectively (MoEF 2010a). The 2nd INCCA report (consisting of 4 x 4 assessments—a sectoral and regional analysis for 2030s on four key factors like agriculture, water, natural resources and biodiversity and health in four regions, the Himalayas, Western Ghats, coastal areas and Northeast) indicated an overall warming for all the four regions. It also indicated an increase in annual temperature between 1.7°C and 2.2°C in the 2030s (as compared to the 1970s), with extreme temperature increasing by 1–4°C, and with maximum increase in the coastal regions. Increase in precipitation is highest in the Himalayan region and lowest in the northeastern region (MoEF 2010b).

Rise of Sea Level and Inundation of Coastal Areas

The IPCC's projected sea-level rise could result in flooding of the habitats of millions of people in the low-lying areas of South, South-East and East Asia such as in Vietnam, Bangladesh, India and China (Stern 2007). According to even the most conservative scenario, it is predicted that by the end of the 21st century, sea level will be about 40 cm higher than today. This will increase the number of people affected by floods every year along coastlines from 13 million to 94 million. Almost 60 percent of this increase will occur in South Asia,

along the coast, from Pakistan through India, Sri Lanka and Bangladesh to Burma (Wassmann et al. 2004).

According to the 2nd INCCA report (MoEF 2010b) the sea level along the Indian coast has been rising at the rate of 1.3mm/yr and is likely to rise in consonance with the global sea-level rise in the future. Sea-level rise not only inundates land, but increases the salinization impact of waves and storm surges, damaging agriculture and drinking water sources and badly affecting soil conditions, while also eroding shore-lines.

Increased Soil Salinity

Many of these impacts are already visible in coastal Odisha, Andhra Pradesh and Tamil Nadu. Thousands of inhabitants of Sundergarh district of Odisha have already been displaced due to these impacts. Large areas in coastal Andhra and Odisha have suffered a double whammy: while agricultural productivity has gone down, companies are buying up these lands at cheap rates from the distressed peasants and converting these to large shrimp and prawn farms, often with government subsidies. In the last 10 years, this remarkable change has become very visible in these areas. The well known cases of the Sundarbans islands losing 25–40 percent of their land area (though compounded by subsidence, due to silt loading) is an example.

Fishing Practices Affected

The rising seas have started affecting the fishing communities in India in more than one way: not only do they face wholesale physical and livelihood displacement in case of any future inundation of coastal areas and fresh cyclonic storms, but fish availability in near sea has already reduced in many areas, affecting millions of fishing communities' livelihoods. Reduced availability of fish near the shore has its greatest effect on the generally poor traditional fishworkers who use non-mechanized boats. They then have to go into the deep sea in search of fish at great physical risk.

Fisher people along the entire eastern coast in West Bengal, Odisha and Andhra report diminishing fish catches: fish yield in the near sea has reduced substantially in recent years, and Bengali fish workers in Medinipur that there is no longer any easy *Hilsa* catch—the tides do not bring them. It appears that the fish is available only in the ‘deep sea.’ Hence, those with access to powered boats (called ‘*bhutbhuti*,’ because of the sound their diesel engines make) and bottom-hugging nets, manage to survive as they can go further out, but the poorer ones with dinghy and floater nets are being gradually driven out of their hitherto-profitable occupation. On another level, even the smaller motor-boats are increasingly challenged by larger fishing trawlers; the latter can cover more area in less time while the smaller boats can only use a limited zone.

This can be called a typical example of common but differentiated impacts; climate change impacts follow the class divide.

Soil Erosion and Inundation

All along the long Indian coast, the sea is eating away the land. In 2009, several small towns—such as Ullal in south Karnataka near Mangalore—reported severe and continuing erosion of beaches. In Arattupuzha village of Kerala, coast dwelling fisher people try to hold on to their crumbling huts with ropes tied to big boulders. The sand of the beaches is continually being eroded by stronger waves, and access roads built close to beaches are washed away almost every year; new ones then have to be built further inshore. This can best be seen in the rapidly receding shoreline in West Bengal, both in 24 Parganas near the Sundarbans and in East Medinipur; the popular sea resorts of Bakkhali and Frazerganj in the first and Shankarpur in the second wage a perpetual battle against an advancing sea. The advancing sea means that fisher peoples lose vital berthing space for their boats, drying areas for their fish, and in many cases, their seasonal homes.

In the picture-perfect Konkan coast of Maharashtra, the Arabian Sea is getting angrier. According to a 20-year study being led by

Shrikant Karlekar, the sea level along the west coast of Maharashtra has gone up by five to six centimetres (50 to 60 millimetres, or 2.5 to 3 mm/year) in the past 20 years. This is about double the rate claimed by the INCCA studies, which cite an 'average 1.3 mm rise per year,' and is closer to the global figure of 2–3 mm/year. This is causing even higher 'high tides' every year. This rise has resulted in invading of salt water in areas up to one kilometre inland, beach erosion, creeks filling up with sand and mangroves being damaged. Sindhudurg seems to be the worst affected, with a single village—Deobagh in Malwan Tehsil—losing 32 ha of land in the last 30 years, including homes and economically productive coconut groves. Many other villages here have similar tales to tell.

In many of the Indian mangrove wetlands, freshwater reaching the mangroves has been considerably reduced since the late 19th century, mainly due to diversion of freshwater in the upstream areas. This could lead to the destruction of 75 percent of mangroves in the Sundarbans. Further destruction of the Sundarbans mangroves would diminish their critical role as natural buffers against tropical cyclones (UNESCO World Heritage Centre 2007). Unnikrishnan et al. (2006) have shown that global warming may cause changes in the regional climate of the Bay of Bengal and could lead to more intense tropical cyclones and high surges.

It has been predicted that if a one-metre sea-level rise were to take place today, it would displace seven million people in India. More than 20,000 people had already been displaced in the Sundarbans area alone; an entire village, named Lohachara, has disappeared into the sea, and half the area of Ghoramara, another village, is under water.

A 2007 study on Mousuni Island in the western Sundarbans showed that almost 13 percent of the families are impacted by storm surges on an annual basis, while about 18 percent are impacted at least once in five years. Salinization of the soil by sea water incursion has affected about 89 percent of farming families. In August 2008, a 400 metre stretch of embankment along the western border of the village of Baliara was breached, affecting 26 hectares of agricultural

land. In May 2009, Baliara lost 900 metres of the embankment while its northern neighbour Kusumtala lost 1200 metres. It has also been observed that more than 14 percent of the land mass of the island has been lost since 1969 (WWF-India 2010).

Increased Temperatures and Changes in the Rain Cycle

The agricultural sector represents a major part of India's Gross National Product (GNP), and as such plays a crucial role in the country's development. The impact of climate change on agriculture could ultimately result in reduced food security as well as livelihood displacement for a large chunk of the population. Climate change already affects crop yields (both positively and negatively) at an increasing rate, as important inputs such as water and solar radiation became either scarce or erratic, and pests increase or mutate.

According to the IPCC-AR4, in the past 100 years, the surface temperature of India has risen greatly, with considerable adverse effect on crop yields. The resulting changes in temperatures and rainfall have had a direct impact on the production of kharif crops. One study suggests that there is threat of a 2–5 percent decrease in yield potential of wheat and maize in India (Aggarwal 2003).

Impacts on Crop Productivity

The IPCC-AR4 suggests that there is a probability of 10–40 percent loss in crop productivity in India by 2080–2100 due to global warming, despite the beneficial aspects of increased carbon dioxide. Due to a three to six degree increase in temperature in the Indo-Gangetic plains during March 2004, the wheat crop matured 10 to 20 days earlier, thus causing huge losses in overall wheat production and threatening the livelihood security of farmers. Losses were also significant for mustard, peas, tomatoes, onion, garlic and other vegetable and fruit crops (Samra and Singh 2004: 32). Aggarwal (2008) has indicated the possibility of a loss of four to five million tonnes in wheat production for every rise of one degree in temperature, assuming current land use.

In most of the Western Ghats region, the monsoon rainfall is likely to increase by up to 15 percent, whereas in the eastern part of the Western Ghats, the rainfall is projected to decline by about 20 percent. The impact of climate change was assessed for major cereals using the A1b 2030 scenario derived from the PRECIS regional climate model (RCM), provided by the Indian Institute of Tropical Meteorology (IITM), Pune. The resulting study indicates that most of the mountainous Western Ghats region will see irrigated rice yields fall by about 4 percent. In case of rain-fed rice, a large portion of the region likely to lose rice yields up to 10 percent (Kumar et al. 2011).

Climate change is also causing unusual levels of cold in some areas. In the winter of 2009–10, the mustard crop in 16 districts of Rajasthan was severely affected as a result of unprecedented ground-frost for days.

The 2002 monsoon was one of the shortest in recorded history. In July 2002, rainfall adequacy dropped to 51 percent, surpassing all previous recorded droughts (in 1877, 1899, 1918, 1972 and 1987). The impact of the drought spread over 56 percent of the land mass of India and threatened the livelihoods of 300 million people across 18 States. No other drought in the past led to as large a drop in food production as the 2002 drought (PACS Programme n.d.). Foodgrain production dipped by 29 million tonnes i.e. from 212 million tonnes in 2001 to 183 million tonnes. The total loss in rural employment due to shrinkage of agricultural operations during the drought months was estimated at 1250 million man-days.

Over 18 million hectares of cropped area were left unsown during the kharif season. The percentage fall of kharif crop acreage, as compared to the normal, was the highest in Kerala (–59.3 percent), followed by Rajasthan (–40.9 percent), Tamil Nadu (–27.3 percent) and Uttar Pradesh (–19.4 percent).

During the rabi season, Rajasthan led the pack (–52.1 percent), as only 31.95 lakh hectares were sown against the normal of 66.69 lakh hectares. The other two States affected during the rabi season were Gujarat (–27.9 percent) and Tamil Nadu (–24.6 percent). Rabi crops are usually supported by irrigation. However, during 2002–03, the fall in

rabi output was over 8 percent, or 8 million tonnes. This makes it the largest rabi drought in any drought year. Thus, the drought of 2002 highlighted the vulnerability of irrigated areas to drought (PACS Programme n.d.).

Gosain and his co-researchers (2011) studied the possible impacts of climate change on water resources of the river basins in India, which can be a major cause of drought. They mapped likely reductions in water availability in the Indian river basin through SWAT modelling due to increase in temperature.

According to the INCCA report (2010) (Sharma and Chauhan 2011), maize and sorghum are projected to have reduced yields in all the regions. However, the report also estimates that irrigated rice in parts of southwestern Karnataka and the northern-most districts of Kerala is likely to gain in yields marginally due to warming, as compared to the rain-fed crop. Coconut yields are also projected to increase by 30 percent in majority of the region in the Western Ghats due to climate change, as the rainfall is projected to increase by up to 15 percent during the November to March period, causing the ambient temperature to shift towards the optimum for growth of coconut during this period (Kumar et al. 2011).

One of the most challenging aspects of adapting crops to climate change will be to maintain their genetic resistance to new species of pests (and new diseases), including weeds, herbivorous insects, arthropods, nematodes, fungi, bacteria and viruses. Rising temperatures and variations in humidity affect the diversity and responsiveness of agricultural pests and diseases and are likely to lead to new and perhaps unpredictable epidemiologies, thereby making the crop more vulnerable. Changes in cropping systems can also lead to the development of new pathogens.

The Changing Monsoon

According to all available data, and field observations coming from all parts of the country, the change in India's climate is likely to be most manifest through disruptions in the monsoon cycle. Such

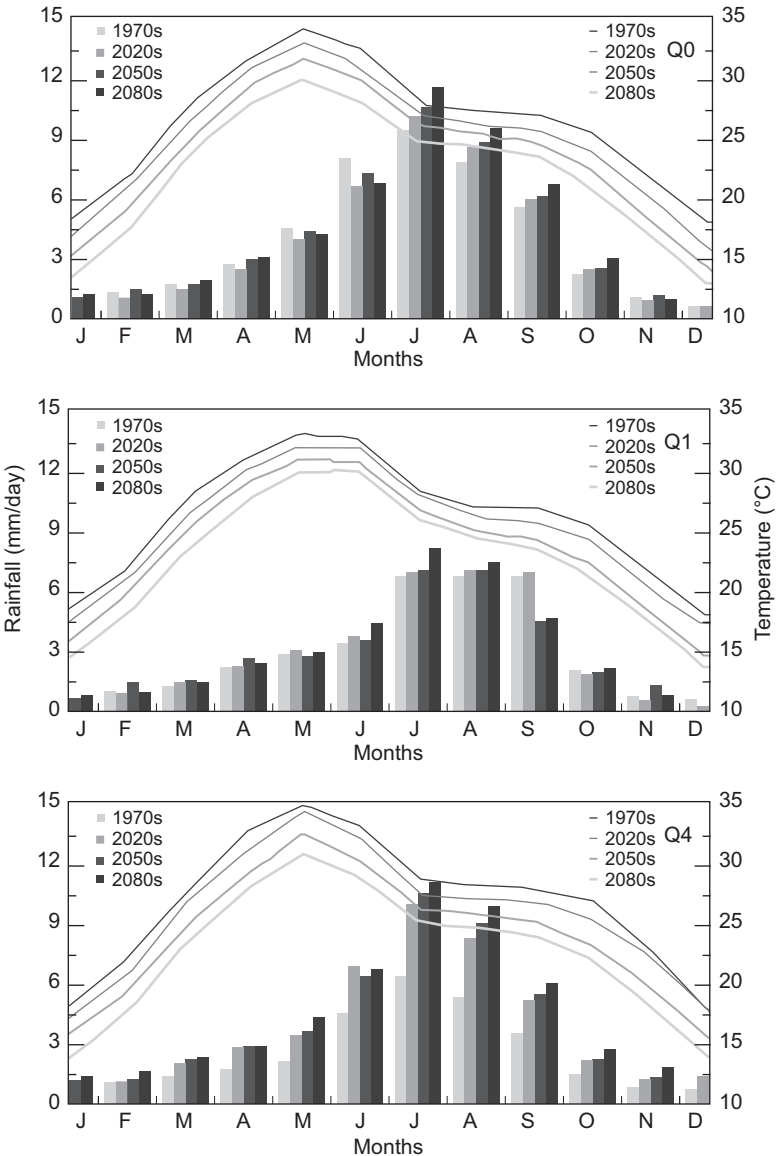
changes will include longer dry periods in most parts of the Gangetic plains, the forested central uplands, the Himalayan region and in western India, greatly affecting water availability in those areas, and thus in turn all water-dependent agriculture. Gupta and Deshpande (2004) predict that the gross per-capita water availability in India will decline from $\sim 1820 \text{ m}^3/\text{yr}$ in 2001 to as low as $\sim 1140 \text{ m}^3/\text{yr}$ in 2050. The Central Water Commission (2010) predicts a yet grimmer picture: the country will reach a state of 'water-stress' before 2025, when the availability will fall to below 1000 m^3 per capita. The 2010 assessment report by the Ministry of Environment and Forest suggests that the Himalayan region will experience moderate to extreme drought severity from 2030 onwards (MoEF 2010b).

There were consecutive droughts in the eastern Indian States in 2009 and 2010, in spite of 2010 being a fairly strong La Nina year (following the 2009 El Nino), which generally brings good rains to the south-west monsoon.

Further, during studies using Hadley Centre's high resolution regional climate model, PRECIS (Providing Regional Climates for Impact Studies), three different simulations (Q0, Q1 and Q14) showed a 16 percent, 15 percent and 9 percent rise in monsoon rainfall across the country except Tamil Nadu and Andhra Pradesh, in which the model predicted a slight decrease in the rainfall (Krishna Kumar et al. 2011). It is also predicted that the number of rainy days will show varying changes over India in response to global warming (Figure 1.6) (*ibid*). The analysis showed decrease in the number of rainy days over the west coast, central India and the Indo-Gangetic plains and increase over northwest India and the east peninsula.

Rainfall over Kerala, Chhattisgarh and Jharkhand has been showing a significant decreasing trend, while there has been an increasing trend over the coastal areas of Andhra Pradesh, north interior Karnataka, central Maharashtra, the Konkan, Goa, Jammu and Kashmir, western Uttar Pradesh and Gangetic West Bengal. While the contribution of July rainfall to the overall monsoon exhibited a decreasing trend, the contributions in June and August exhibited an increasing trend.

FIGURE 1.6: Annual Cycles of All India Mean Rainfall (bars) and Surface Air Temperature (lines) Simulated by PRECIS for the 1970s, the 2020s, the 2050s and the 2080s



The southwest monsoon is crucial, considering that on an average it accounts for about 75 percent of the country's total annual rainfall. Within the monsoon period, rainfall during July is all the more important as it has a great bearing on agricultural activity in the country.

Another detailed modelling study done at Purdue University on the impact of warming on our southwest monsoon, suggests that both the amount of rainfall and the onset of the monsoon are going to change significantly in the coming decades. Predictability and prior information/knowledge about weather phenomena is the mainstay of smallholder farming in poor countries, and climate change is creating uncertainties and making traditional weather knowledge less useful—rendering ecosystem communities like small farmers, agricultural workers and fisher peoples all the more vulnerable.

Less rainfall will affect not only crop productions but also agricultural ecosystems as a whole. The availability of fodder grasses and plants will be reduced greatly. This, coupled with heat stress from higher temperature, and limited water intake due to a decrease in rainfall could cause reduced milk yields in animals and increased incidences of diseases (Sukumar et al. 2003; Christensen et al. 2004).⁶

Floods and Melting of Glaciers

Climate change is likely to result in many parts of the country suffering from recurrent droughts and battling water scarcity, while others reel from floods. Luni, Kutch and Saurashtra regions are likely to face acute scarcity of water, as are the river basins of the Mahi, the Pennar, the Sabarmati and the Tapti. The river basins of the Cauvery, the Ganga, the Narmada and the Krishna will experience seasonal or regular water-stressed conditions. The rivers Godavari, Brahmani and Mahanadi, on the other hand, will not have water shortages but are predicted to face severe flood conditions (Gosain et al. 2011). The Himalayas, the Western Ghats, coastal areas and the northeast are likely to experience floods exceeding the existing magnitude by 10–30 percent (Krishna Kumar et al. 2011).

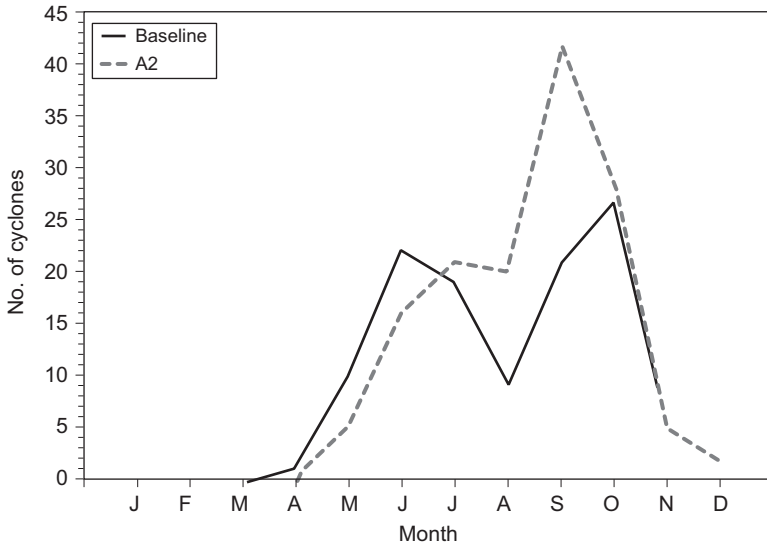
Himalayan glacial snowfields store about 12,000 km³ of freshwater. Hence, climate-change-related melting of glaciers could seriously affect half a billion people in the Himalaya, Hindu-Kush region who depend on glacial melt to meet their water needs (Tserendash et al. 2005; WWF 2005: 79). The current trend of glacial melting suggests that the Ganga, Indus, Brahmaputra and other rivers that criss-cross the northern Indian plain may become seasonal rivers in the near future as a consequence of climate change. This may affect the river-dependent economies in the region.

Studies by Anil Kulkarni and others (2007) show that many glaciers in the Indian Himalayas have lost somewhere between 12 to 38 percent (on average, about 21 percent) of their ice covered area over the period 1962–2004, as shown in satellite data, in contrast to a handful which have gained—such as the Siachen glacier. Many smaller glaciers have fragmented, thus increasing the rate of melting. Using ground penetrating radar, GPS, laser range finders and spectral radiometers, Kulkarni (1992) has also shown that even in mid-winter, the melting is accelerating, influencing stream run-off—which is vital for mountain agriculture, forests, wildlife and for maintaining downstream rivers. Much of this glacier data has been verified by ‘ground-truthing,’ by scientists from HNB Garhwal University in Uttarakhand and other agencies.

Melting of glacial and non-glacial snow/ice is happening at a faster pace in South Asia than in many other places at similar latitudes. Over the last 10 years, many areas in the middle Himalayas have lost considerable non-glacial snow/ice cover; this has attracted much less official attention. In addition, GLOFs (glacial lake outburst floods) are increasing in many parts of the middle Himalayas.

Increased Threat of Cyclones

Increased occurrences of extreme events due to climate change will affect the poor the most, as evinced by the experience of the 1996 cyclone in Andhra Pradesh, in which more than 1000 people died.

FIGURE 1.7: Frequency Distribution of Cyclones in the Bay of Bengal

A recent analysis by Unnikrishnan and others (2011) suggested an increase in the frequency of cyclones in the Bay of Bengal during the late monsoon, in the month of August and September, compared to the baseline scenario (Figure 1.7).

Increased Risk of Disease

Climate change will also lead to more diseases. Frequent floods and sea-level rise will degrade the surface water quality (owing as well to increased pollution) and, hence, lead to more water-borne infectious ailments such as dermatitis, cardiovascular diseases and gastrointestinal diseases (Tong and Ying 2000).

Climate change will most likely affect both spatial and temporal distribution of malaria and other vector borne diseases. Temperature can directly influence the breeding of malaria protozoa and suitable climate conditions can intensify the invasiveness of the mosquito

(Bonita, et al. 2006). The transmission of malaria is also predicted to increase in the country. Malaria being endemic in most parts of India, such as the central and eastern Indian regions covering Madhya Pradesh, Jharkhand, Chhattisgarh, Orissa, West Bengal and Assam, it is expected to spread to newer areas with the change in climate (Bhattacharya et al. 2006).

Malarial transmission projections based on temperature change revealed introduction of new zones in Jammu and Kashmir and Uttarakhand. Incidence of malaria may increase in Arunachal Pradesh and there may be more months of transmission in the districts of the Himalayan region, northeastern States and the Western Ghats. In the northeastern States, intensity of transmission is projected to increase from 7–9 months to 10–12 months. The Western Ghats is projected to be affected at a minimum (Dhiman et al. 2011).

Impacts on Forests

Climate change is expected to affect the boundaries of forest types and areas, primary productivity, species populations and migration, occurrence of pests and diseases and forest regeneration. The increase in GHGs also affects species composition and the structure of ecosystems, which, in turn, affects ecosystem functions (Schutze and Mooney 1994). Climate change will have a profound effect on the future distribution, productivity, and health of forests, leading to significant decline in alpine and cryospheric ecosystems (Xiao et al. 1998).

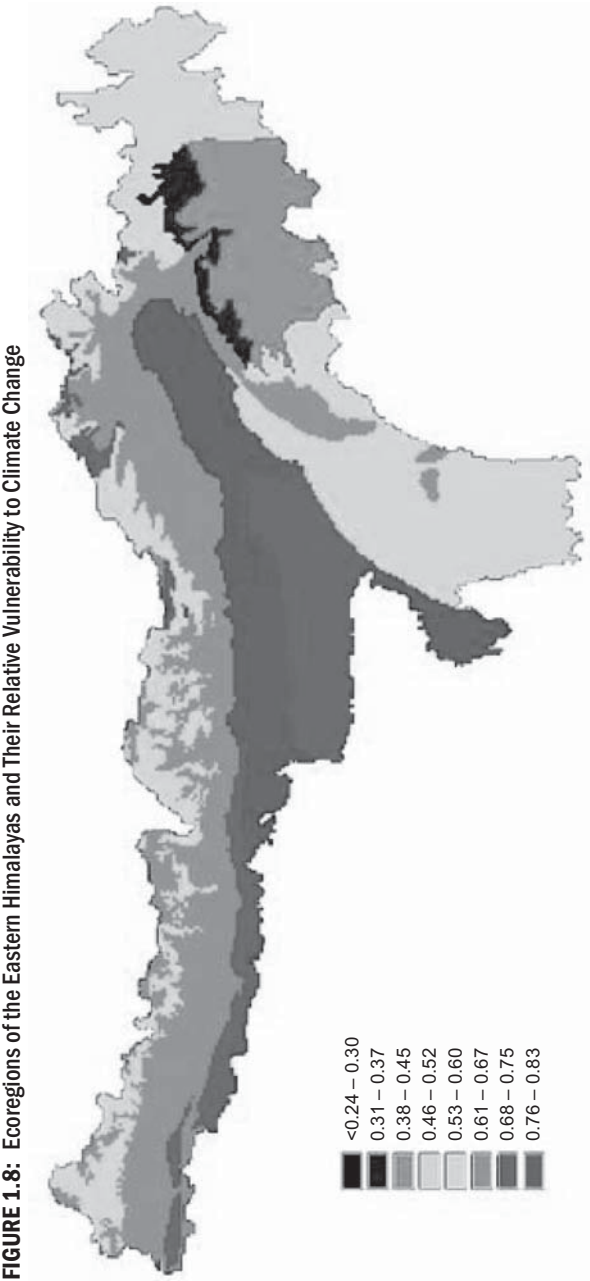
The response of ecosystems to climate change in mountain regions will be most important at ecoclines (gradual ecosystem boundaries, where one forest type meets another) and at ecotones (where step-like changes in vegetation types occur). Guisan et al. (1995) noted that ecological changes at ecoclines or ecotones will be amplified due to change in climate because changes within adjacent ecosystems are juxtaposed. It has also been observed that species may respond to changes in climatic variables by adapting, shifting ranges,

changing occurrence patterns, or disappearing altogether. This means that while some species may shift their geographic ranges, some may be unsuccessful in reaching or colonizing new habitats, leading to serious biodiversity loss.

McNeely (1990) suggested that the most vulnerable species at the interface between two ecosystems will be those that are genetically poorly adapted to rapid climate change. Those that reproduce slowly and disperse poorly and those that are isolated or highly specialized will, therefore, be highly sensitive to seemingly minor stresses. The Brahmaputra valley semi-evergreen forests were identified as the most vulnerable of the 25 ecoregions in the eastern Himalayas. The least vulnerable are the Northern triangle and Indochinese forests. Other vulnerable areas are the moist deciduous forests of the lower Gangetic plains, sub-tropical forests of Meghalaya, savanna and grasslands of Terai-Duar, and sub-alpine conifer forests of northeastern Himalayan (Shrestha and Devkota 2010).

India's forests account for about 20 percent (64 million ha) of its geographical area. One climate impact assessment for Indian forests showed that about 45 percent of the forested grids (forest areas) in the country are projected to undergo change (Gopalakrishnan et al. 2011; Ravindranath et al. 2011).⁷ The upper Himalayan stretches, parts of central India, northern Western Ghats and the Eastern Ghats are more vulnerable. Climate change impacts are predicted to be larger for regions at higher elevations.

In other words, large stretches of forest vegetation will no longer be able to adapt to their niche habitats because the habitats will no longer be climatically suitable. Further, since different species respond differently to changes in climate, it is expected that a few species may show a steep decline in populations and, perhaps, even local extinctions. This, in turn, will affect the other populations dependent on the already affected species, which will eventually lead to major changes and loss in biodiversity. Thus, climate change could cause irreversible damage to unique forest ecosystems and biodiversity, rendering several species extinct locally and, possibly, globally (Ravindranath 2006). Further, climate change will force some plant and animal



Source: ICIMOD.

species to migrate as they are unable to adapt to their changing environments, which poses a problem for the conservation of biodiversity hotspots (some of which are listed as natural World Heritage Sites).

Because the forest-dependent communities use herbs, tubers and plant parts both for food and medicinal purposes, and collect and process such non-timber forest produce (NTFP) for their livelihoods, local extinction of species and a general scenario of reduced species availability will adversely affect the food base, health and livelihood of many such communities. Agriculture in the Indian mountains—mainly the Himalayas—is often practiced in (and ecologically dependent on) the adjoining forests, and a change in forest vegetation and forest humus will also affect it, as soil organisms beneficial to agriculture disappear and forests become drier (or wetter). As we saw earlier, climate change is also leading to more forest fires.

1.4 Climate Change and India: Are We Ready to Cope?

In the light of available scientific data, some of which we presented above, and an assortment of field observations of journalists, researchers and social activists, we can safely say that climate change and its multi-layered impacts will most likely devastate India's economy and environment, displacing and pauperizing about two-thirds or more of the country's population. Huge areas of India's long coastline will be under sea water in another 50 years; according to Hansen, this will occur much earlier, and at least one populated island in the Sundarbans has already disappeared completely. Glacial melt and low rainfall will play havoc with the mountain environment, successive droughts will disrupt and perhaps, in the end, destroy the country's agriculture, and the forests will often change beyond recognition.

Beyond the few scientific studies and the government's often extremely unclear statements on climate issues, do we, as a country, understand much about the disaster that is staring us in the face? Are we in a position to cope with the changing climate (or 'adapt,' as it is called in the climate action papers)? Do we understand sufficiently what is causing climate change and what needs to be done to combat

the crisis? Is the Indian government responsive? If not, why not? If so, are its responses adequate?

In the next chapters we will try to find answers to these questions.

Notes

1. El Nino/La Nina is a quasi-periodic climate pattern that occurs across the tropical Pacific Ocean roughly every five years. The two variations are coupled: the warm oceanic phase, El Nino, accompanies high air surface pressure in the western Pacific, while the cold phase, La Nina, accompanies low air surface pressure in the western Pacific. The accepted definition is a warming or cooling of at least 0.5 C (0.9 F) averaged over the east-central tropical Pacific Ocean. Typically, this anomaly happens at irregular intervals of 3–7 years and lasts nine months to two years. The average period length is five years. When this warming or cooling occurs for only seven to nine months, it is classified as El Nino/La Nina ‘conditions,’ when it occurs for more than that period, it is classified as El Nino/La Nina ‘episodes.’
2. Concentration of CFCs in the atmosphere is stabilizing of late as a result of the implementation of the Montreal Protocol decision to phase them out.
3. The amount of carbon dioxide can be obtained by multiplying this figure by 3.667.
4. United Nations Environment Programme (UNEP), Bonn (Germany), 18 August 2010. According to United Nations Environment Programme: ‘The catastrophic wildfires that have swept across Russia this summer have killed at least 50 people and could cost the country’s economy an estimated US\$15 billion. But among the hidden victims of the fires are small, nocturnal animals that are fast losing their habitats. Russia’s bat population—which boasts some 30 species—has been hit especially hard by the flames. The areas worst affected by the wildfires are concentrated in western Russia, one of the most important breeding and foraging areas for the country’s bat species. Although no official assessments have been carried out, recent satellite images show that more than one million hectares of forests have been destroyed in western Russia.’ Regarding Canada in 2011, the UNEP said that ‘In one of the worst northern insect attacks, more than 16 million hectares (39.54 million acres) of pine forest in British Columbia have been killed in a decade long-infestation by mountain pine beetles, which has now entered Alberta. The U.S. states of Colorado and Wyoming also are badly hit. Jim Bouldin, an ecologist at the University of California Davis, said there was strong evidence that the beetles had moved northwards and to higher elevations in Canada and the United States to forests that had been free of attacks for many hundreds of years. The British Columbia government has stressed that climate change is

a big factor in the beetle spread, mainly on old lodge-pole pines.' Repeated incidents of large-scale coral die-outs is another major threat to earth's life-support systems.

Many research studies have predicted large die-back of the massive Amazonian forests—a huge carbon sink and repository of world's biodiversity.

5. Many plant and animal species are unlikely to survive climate change. New analyses suggest that 15–37 percent of a sample of 1103 land plants and animals would eventually become extinct as a result of climate changes expected by 2050. For some of these species, there will no longer be anywhere suitable to live. Others will be unable to reach places where the climate is suitable. The IPCC's 2002 report, *Climate Change and Biodiversity* states: 'Globally by the year 2080, about 20% of the coastal wetlands could be lost due to sea-level rise.' Coastal wetlands are one more large repository of species diversity.
6. *Geophysical Research Letters*, 3 Jan.
7. Net Primary Productivity increases by an average of 30.3 percent by 2035 and by 56.2 percent by 2085. Observable Increase in the North eastern region is notable probably due to warmer and wetter climate. This might increase biomass and soil carbon content, leading to probable changes in vegetation type. The districts of southern parts of the northeast are more vulnerable.

References

- Aggarwal, P.K. 2003. 'Impact of Climate Change on Indian Agriculture,' *Journal of Plant Biology*, 30: 189–98.
- . 2008. 'Global Climate Change and Indian Agriculture: Impacts, Adaptation and Mitigation,' *Indian Journal of Agricultural Science*, 78(11): 911–19.
- Bhattacharya, S., C. Sharma, R.C. Dhiman and A.P. Mitra. 2006. 'Climate Change and Malaria in India,' *Current Science*, 90(3): 369–75.
- Bonita, R., R. Beaglehole and T. Kiellstrom. 2006. *Basic Epidemiology*. 2nd edition. Switzerland: World Health Organization.
- Buddemier, R.W. and D.G. Fuatin. 1993. 'Coral Bleaching Relative to Elevated Seawater Temperature in the andaman Sea (Indian Ocean) over the last 50 Years,' *Coral Reefs*, 15: 151–52.
- Central Water Commission (CWC). 2010. 'Water and Related Statistics,' report of the Ministry of Water Resources. New Delhi: Ministry of Water Resources, Government of India.
- Christensen, L., M.B. Coughenour, J.E. Ellis, and Z.Z. Chen. 2004. 'Vulnerability of the Asian Typical Steppe to Grazing and Climate Change,' *Climatic Change*, 63: 351–68.

- Cox, P.M., R.A. Betts, M. Collins, P.P. Harris, C. Huntingford and C.D. Jones. 2004. 'Amazonian Forest Dieback under Climate-Carbon Cycle Projections for the 21st century,' *Theoretical and Applied Climatology*, 78: 137–56. Available at http://www.seas.harvard.edu/climate/eli/Courses/EPS134/Sources/19-Biosphere-feedbacks-amazon-rainforest-and-permafrost/amazon-dying/Cox-Betts-2004_Amazonian-forest-dieback-under-climate-carbon_TAC.pdf.
- Dhiman R., L. Chavan, M. Pant and S. Pahwa. 2011. 'National and Regional Impacts of Climate Change on Malaria by 2030,' *Current Science*. 101(3): 372–83.
- Gopalakrishnan, R., M. Jayaraman, G. Bala and N.H. Ravindranath. 2011. 'Climate Change and Indian Forests,' *Current Science*, 101(3): 348–55.
- Gosain, A.K., S. Rao and A. Arora. 2011. 'Climate Change Impact Assessment of Water Resources of India,' *Current Science*, 101(3): 356–71.
- Guisan, A., J. Holten, R. Spichiger, L. Tessier (eds.). 1995. 'Potential Impacts of Climate Change on Ecosystems in the Alps and Fennoscandian Mountains: An Annex to the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report, Working Group II-C (impacts of climate change on mountain regions),' Publication Series of the Geneva Conservatory and Botanical Gardens. Geneva: University of Geneva.
- Gupta, S.K. and R.D. Deshpande. 2004. 'Water for India in 2050: First-Order Assessment of Available Options,' *Current Science*, 86: 1216–24.
- Hansen, J., R. Ruedy, M. Sato and K. Lo. 2010. *Global Surface Temperature Change*. New York: NASA Goddard Institute for Space Studies.
- Hansen, James et al. n.d. 'Target Atmospheric CO₂: Where Should Humanity Aim?' Available at <http://arxiv.org/ftp/arxiv/papers/0804/0804.1126.pdf>.
- Jones, Phil. 2012. *Global Temperature Record*. Climatic Research Unit and the UK Met. Office Hadley Centre. Available at <http://www.cru.uea.ac.uk/cru/info/warming/>.
- Keeling, R.F., S.R. Shertz. 1992. 'Seasonal and Interannual Variations in Atmospheric Oxygen and Implications for the Global Carbon Cycle,' *Nature*, 358: 723–27.
- Krishna Kumar, K., S. K. Patwardhan, A. Kulkarni, K. Kamala, K. Koteswara Rao and R. Jones. 2011. 'Simulated Projections for Summer Monsoon Climate over India by a High Resolution Regional Climate Model (PRECIS),' *Current Science*, 101(3): 312.
- Kulkarni, Anil, 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(1).
- Kulkarni, Anil. 1992. 'Mass Balance of Himalayan Glaciers using AAR and ELA methods,' *Journal of Glaciology*, 38(128): 101–4.
- Kumar, S. Naresh, P. K. Aggarwal, Swaroopa Rani, Surabhi Jain, Rani Saxena and Nitin Chauhan. 2011. 'Impact of Climate Change on Crop Productivity in

- Western Ghats, Coastal and Northeastern Regions of India,' *Current Science*, 101: 332–41.
- McNeely, J.A. 1990. 'Climate Change and Biological Diversity: Policy Implications,' in M.M. Boer and R.S. de Groot (eds.), *Landscape Ecological Impact of Climate Change*. Amsterdam: IOS Press.
- MoEF. 2010a. *India: Green House Gas Emissions 2007*. New Delhi: Government of India.
- . 2010b. *Climate Change and India: A 4x4 Assessment—A Sectoral and Regional Analysis for the 2030s*. New Delhi: Ministry of Environment and Forests, Government of India.
- National Oceanic and Atmospheric Administration 2011, *State of the Climate* report. USA.
- PACS Programme. n.d. *Drought in India: Challenges and Initiatives*. New Delhi: Poorest Areas Civil Society Programme 2001–2008. Available at <http://www.empowerpoor.org/downloads/drought1.pdf>.
- 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., Sandhya Rao, Nitasha Sharma, Malini Nair, Ranjith Gopalakrishnan, Ananya S. Rao, Sumedha Malaviya, Rakesh Tiwari, Anitha Sagadevan, Madhushree Munsli, Niharika Krishna and Govindasamy Bala. 2011. 'Climate Change Vulnerability Profiles for North East India,' *Current Science*, 101(3): 384–94.
- Samra, J.S. and G. Singh. 2004. *Heat Wave of March 2004: Impact on Agriculture*. New Delhi: Indian Council of Agricultural Research.
- Scheffer, Marten, Victor Brovkin and Peter M. Cox. 2006. 'Positive Feedback between Global Warming and Atmospheric CO₂ Concentration Inferred from Past Climate Change,' *Geophysical Research Letters*, 33.
- Schutze, E.D. and H.A. Mooney. 1994. *Biodiversity and Ecosystem Function*. Berlin: Springer Verlag.
- Sharma, S.K. and R. Chauhan. 2011. 'Climate Change Research Initiative: Indian Network for Climate Change Assessment,' *Current Science*, 101(3): 308–11.
- Shrestha, A.B. and L.P. Devkota. 2010. *Climate Change in the Eastern Himalayas: Observed Trends and Model Projections*. Climate Change Impact and Vulnerability in the Eastern Himalayas—Technical Report 1. Kathmandu: ICIMOD.
- Solomon, S.D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). 2007. *Climate Change 2007: The Physical Science Basis*. Cambridge and New York: Cambridge University Press.
- Stern, N. 2007. *Review on the Economics of Climate Change*. Cambridge: Cambridge University Press.

- Sukumar, R., K.G. Saxena and A. Untawale. 2003. 'Climate Change Impacts on Natural Ecosystems,' in P.R. Shukla, S.K. Sharma, N.H. Ravindranath, A. Garg and S. Bhattacharya (eds.), *Climate Change and India: Vulnerability Assessment and Adaptation*. Hyderabad: Orient Longman.
- Thomas, Chris D. et al. 2004. 'Extinction Risk from Climate Change,' *Nature*, 427: 145–48.
- Thoning, K.W., P.P. Tans, and W.D. Komhyr. 1989. 'Atmospheric carbon dioxide at Mauna Loa Observatory 2. Analysis of the NOAA GMCC data, 1974–1985,' *J. Geophys. Research*, 94: 8549–65.
- Tong, S.L. and L.V. Ying. 2000. 'Global Climate Change and Epidemic Diseases,' *Journal of Disease Control*, 4: 17–19.
- Tserendash, S., B. Bolortsetseg, P. Batima, G. Sanjid, M. Erdenetuya, T. Ganbaatar and N. Manibazar. 2005. 'Climate Change: Impacts on Pasture,' in P. Batima and B. Bayasgalan (eds.), *Climate Change Impacts*. Ulaanbaatar: Admon Publishing.
- Turley, Carol and Kevin Boot. 2010. *Environmental Consequences of Ocean Acidification: A Threat to Food Security*. UNEP Emerging Issues. Nairobi: UNEP.
- UNESCO World Heritage Centre. 2007. *Case studies on climate change and world heritage*. France: UNESCO World Heritage Centre.
- Unnikrishnan, A.S., K.R. Kumar, S.E. Fernandes, G.S. Michael and S.K. Patwardhan. 2006. 'Sea-level Changes along the Indian Coast: Observations and Projections,' *Current Science*, 90(3): 362–68.
- Unnikrishnan, A.S., M.R.R. Kumar and B. Sindhu. 2011. 'Tropical Cyclones in the Bay of Bengal and Extreme Sea-level Projections along the East Coast of India in a Future Climatic Scenario,' *Current Science*, 101(3): 327–31.
- Wassmann, R., N.X. Hien, C.T. Hoanh and T.P. Tuong. 2004. 'Sea-level Rise Affecting the Vietnamese Mekong Delta: Water Elevation in the Flood Season and Implications for Rice Production,' *Climatic Change*, 66: 89–107.
- World Wildlife Fund (WWF). 2005. *An Overview of Glaciers, Glacier Retreat, and Subsequent Impacts in Nepal, India and China*. Nepal: World Wildlife Fund. Also available at <http://wwf.panda.org/?19092/An-Overview-of-Glaciers-Glacier-Retreat-and-Subsequent-Impacts-in-Nepal-India-and-China>.
- WWF-India. 2010. *Sundarbans: Future Imperfect—Climate Adaptation Report*. New Delhi: WWF-India.
- Xiao, X.M., J.M. Melillo, D.W. Kicklighter, Y. Pan, A.D. McGuire, J. Helirich. 1998. 'Net Primary Production of Terrestrial Ecosystems in China and its Equilibrium Responses to Changes in Climate and Atmospheric Carbon Dioxide Concentrations,' *Acta Phytoecologica Sinica*, 22(2): 97–118.

2

The Politics of Climate

C.R. Bijoy, Soumitra Ghosh and Soumya Dutta

2.1 The Context

India, which is vulnerable to climate change more than most other countries (apart from Africa) (Padukone 2010), signed the United Nations Framework Convention on Climate Change (UNFCCC) on 10 June 1992 and ratified it on 1 November 1993. India ratified the Kyoto Protocol on 26 August 2002. In the preceding chapter we saw how India's water resources, biodiversity, coastal and forest ecosystems and agriculture are particularly susceptible to climate change: with, on the one hand, the mean temperature increasing alarmingly, and more precipitation and increase in rainfall on the other. Temperature, rainfall increase and droughts will drastically affect agricultural production. The sea level is expected to increase at the rate of 1.3 mm per year.

Not heeding these very palpable signs of disaster, the high growth-inclined 'rising India' is caught in the feverish grip of a development impulse, spawning enclaves of new found prosperity and intense disaffection, utterly unmindful of the laws and policies that exist for the well being of the masses of the country. The no-holds-barred growth agenda of the modern economy (mainly industry), has triggered as never before a process of enclosing the remaining

commons, and consequently, a chain of resource-grab related rapidly escalating conflicts, distressing the rural economy without any corresponding cushioning, and forcing vast populations to abandon their livelihood base in search of wage labour. Large parts of the country are rebellious and have rapidly been turning into an expanding conflict zone. Parts of them are also declared as 'disturbed areas,' facilitating an overt militarization process in the affected regions.

Impressive growth over the last two decades has teleported India into the status of an emerging global economic major. This in turn has spawned ambitions of India's rich and expanding middle class to make India into a strategic geopolitical major power in the global arena, extracting economic concessions. India's role in the UNFCCC and climate change politics is to be understood against this backdrop, which, therefore, includes re-positioning the country in the global political map.

2.2 The Climate Talks: Speculating With the Future

Nineteen years of negotiations under the UNFCCC—the treaty¹ to stabilize global greenhouse gas (GHG) concentrations—has so far failed to set any binding targets in place. Setting no mandatory limits on greenhouse gas (GHG) emissions for individual countries and with no enforcement mechanism, the treaty provides for 'protocols' (updates), the Kyoto Protocol being the principal update so far. The UNFCCC did, however, recognize man-made climate change as a major issue. Ironically, Agenda 21, the lofty action-plan for sustainable development—focused on a healthy economy with a high quality environment—was also signed by 179 countries alongside the UNFCCC treaty at the United Nations Conference on Environment and Development (UNCED), also known as the Rio Earth Summit, in 1992 at Rio de Janeiro, Brazil.

Scientists pointed out the reality of the phenomenon of global warming as early as the 1970s. In the backdrop of droughts in Europe, Soviet Union and Africa, heavy monsoons in India, cold waves in Brazil and the U.S., and the El Nino Southern Oscillation

of Peru, the first World Climate Conference was held in Geneva, Switzerland. Climatologists warned of a rise in global mean temperature and rise of up to one metre in sea levels at the international conference on GHG at Villach, Austria. The Montreal Protocol, initiated by the UN in 1987 to eliminate ozone depleting substances—mainly chlorofluorocarbons—marked the beginning of international cooperation on tackling climate related issues. The Protocol followed the Vienna Convention on the Protection of the Ozone Layer in 1985 and required phasing out of the production and consumption of ozone depleting compounds, such as chlorofluorocarbons (CFCs), carbon tetrachloride and halons by 2000, and methyl chloroform by 2005.

The Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC), an inter-governmental scientific body, was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). It was mandated to assess the risk of climate change caused by human activity. The IPCC, which is now on to its fifth assessment report (to be released in 2014), came up with its first assessment report on climate change in 1990—the first attempt at obtaining the status of climate change and its impacts—as a part of the run-up to the Rio Earth Summit (UNCED). This IPCC Report concluded that global warming could be natural or human induced. The 1995 IPCC Report went one step ahead of this to say that available evidence indicated ‘a discernible human influence on global climate.’ The extent of the influence of human activity on global warming was placed in the 2001 assessment report at ‘66 percent to 90 percent,’ with a 90 to 99 percent probability that the cause was the emissions of GHGs such as carbon dioxide. IPCC concluded in 2001 that the human role was the likely culprit behind global warming. However, it was only in 2007 that the IPCC unequivocally concluded that global warming was indeed occurring and that this was very likely to be the result of human activities.

2.3 UNFCCC: Setting the Terms of Carbon Trade

Defining the Problem and the Solution

The UNFCCC was opened for signatures on 9 May 1992 and entered into force on 21 March 1994. It has been signed by 194 countries, which marks a significant increase from the 166 countries that had signed it initially.² The parties to the Convention have been meeting annually in Conferences of Parties (CoP) since 1995, when it was accepted that targets for emission reductions would be set for the industrialized countries, though these would not be binding. CoP 2 accepted the findings of IPCC's second assessment and opted for a 'flexible approach' to legally-binding mid-term targets. The principle that formed the basis for the negotiations was 'common but differentiated responsibilities' (CBDR),³ which found expression in the Kyoto Protocol. Under this principle, the industrialized countries are to take the first steps in reducing emissions as they have emitted the largest share of historical and current GHGs, and moreover are wealthy enough to incur the costs for the necessary changes in their economies. Furthermore, the per capita emissions of developing countries are lower and can increase in order to meet their social and developmental needs.

The Kyoto Protocol

The CoP 3 in 1997 in Kyoto, Japan, adopted the Kyoto Protocol on Climate Change,⁴ outlining the obligations for reduction⁵ of GHG emissions⁶ for Annex I countries⁷ by 5.2 percent by 2008–2012 from the 1990 level (this was defined as the first emissions budget period).⁸ The Protocol called on all parties to contribute to scientific research and to monitor climate system and greenhouse gases;⁹ to formulate national and regional programmes to improve emission factors;¹⁰ to promote and transfer environmentally sound technologies;¹¹ to strengthen national capacity; and to inventory greenhouse gas emissions and sinks that can remove

these gases from the atmosphere.¹² Increased energy use by developing countries to meet their development needs was underlined in keeping with the CBDR principle. The Protocol, adopted on 11 December 1997, came into force on 16 February 2005. It focused on imposing obligations on Annex I countries to reduce GHG emissions, ranging from an 8 percent reduction for European countries to an increase of 10 percent for Iceland. The Protocol created three ‘flexible’ carbon trading mechanisms, namely emissions trading, the Clean Development Mechanism (CDM)¹³ and Joint Implementation (JI). These were created under pressure from the U.S., which made their inclusion a precondition for signing the treaty, but which still did not sign the final Protocol.

Under the emissions trading mechanism, officially known as the European Union Emissions Trading Scheme (EU-ETS) and more generally as the ‘cap-and-trade’ programme, Annex I parties (from Europe) needing to meet their Kyoto obligations for reducing emissions can buy emissions reductions ‘credits’ (known as EUA) from parties and projects in their own and other Annex I countries, including those that would achieve more emission reductions than what is necessary to comply. If there is a shortage of such credits, credits from CDM projects (known as CERs) in the non-Annex countries of the global South can also be purchased in replacement. But it remains unclear how much of a country’s obligation to reduce emission is to be met through domestic actions to actually reduce emissions, as compared to purchasing credits. The Protocol only has a vague statement that credits must ‘be *supplemental* to domestic actions.’

Other than European Emissions Trading, the two project-based carbon trading schemes are:

1. The Clean Development Mechanism, where the Annex I countries can obtain Certified Emissions Reduction credits (CERs) from parties located in non-Annex I countries hosting GHG reduction projects. A CDM Executive Board set up under the UNFCCC registers projects and, after ensuring that these are duly validated by brokerage or consultancy firms listed as Designated

Operational Entities (DOEs), issues CERs. The CERs represent the reduction achieved (in one tonne of carbon dioxide equivalent units) by the project, as compared to a baseline scenario.

2. Joint Implementation, under which two Annex I countries jointly carry out GHG reduction projects, for which they receive Emission Reduction Units (ERUs) for emission reductions achieved due to the project.¹⁴

Yet another contentious issue was the allocation of credits for 'Land Use, Land-Use Change, and Forestry (LULUCF)' projects under CDM. Such projects include newly planted 'forests' where forests did not exist (afforestation), replanting trees where these have been cleared (reforestation), prevention of deforestation, forest management, grazing land management, revegetation and cropland management.

The Protocol also proposed the creation of an adaptation fund for climate change for minimizing impacts on developing countries, which was to be built out of carbon revenues. Accounting, reporting and review by a Compliance Committee¹⁵ was also envisaged.

Fifty-five of the more developed Annex I countries, accounting for at least 55 percent of emission as of 1990, were required to sign the Protocol before it would come into force. The U.S., as well as Australia and Russia—under U.S. instigation—were against a legally binding agreement. The European Union (EU) and its member countries ratified the Protocol in 2002. The requirement of 55 countries was reached in 2002 when Iceland ratified the Protocol. The 55 percent emission limit was reached in 2004 when Russia signed the protocol. Hence, the Protocol was adopted the following year (2005). Australia signed up only in 2007. As it was so slow to take off, the targets set by the Protocol had by then become unworkable and meaningless.

Evolving Global Mechanisms for Carbon Emission Reduction and Climate Change Adaptation

The CoP 4 adopted a 2-year 'Plan of Action' to devise a mechanism for implementing the Kyoto Protocol. CoP 5 saw the U.S.¹⁶ proposing to

allow credits for carbon ‘sinks’ in forests and agricultural lands to act as substitutes for actual emission reduction. Issues related to non-compliance in meeting emission targets and demands for financial assistance to deal with the adverse impacts of climate change led to the eventual collapse of negotiations. Despite the U.S. declining to participate in the negotiations in CoP 6 and opting to be an observer, its proposals for ‘flexible mechanisms’ were adopted by the Conference. These ‘flexible mechanisms’ included emissions trading, Joint Implementation (JI) and the Clean Development Mechanism (CDM) as substitutes for actual emission reductions. The concept of using tradable carbon credits, drawn from notionally carbon emission reducing industrial projects and carbon sinks to offset carbon emission, gained legitimacy. This idea received reinforcement from financing proposals: a fund for climate change supporting a series of climate measures in the form of a Least Developed Country (LDC) fund (to support National Adaptation Programmes of Action), and a Kyoto Protocol adaptation fund supported by CDM levies and voluntary contributions. Non-compliance, a prickly issue, got pushed out of the negotiations for a later date. The operational rules for the agreements were formalized as the Marrakech Accord in CoP 7 in 2001. Resolutions on transfer of technology by developed countries and minimizing climate change impacts on developing countries were adopted by the Delhi Ministerial Declaration in the CoP 8. It was agreed in the CoP 9 that developing countries need to be supported in adapting to climate change, with such support including capacity-building through technology transfer using the Adaptation Fund. The Buenos Aires Plan of Action adopted in CoP 10 focused on promoting better adaptation to climate change by developing countries.

What Next After Kyoto?

The Montreal Action Plan extracted in the first ‘Meeting of the Parties’—CoP 11/CMP 1¹⁷—cleared the grounds for the entry into force and extension of the life of Kyoto Protocol beyond 2012, the initial expiration date. The developed countries resisted any new

legally binding cuts for the post-Kyoto or post-2012 period unless the cuts covered all the major emitters, including the U.S., India and China. There was an agreement on establishing an 'Ad hoc Working Group,' though, to consider the steps to be taken by developed countries. A 2-year 'dialogue on long-term cooperation' was also launched: to discuss sustainable development, development of adaptation technology and its transfer and market-based opportunities; these talks were however to be limited to existing commitments. The CoP 12/CMP 2 formulated a work programme on subjects for consideration for the post-Kyoto period.

The Bali Action Plan¹⁸ was adopted by the CoP 13/CMP 3 in 2007, and provided a timeline and structured negotiations for the post-2012 or the post-Kyoto framework. However, it failed to acknowledge the problems and the failure of the Protocol in making any tangible and real impact on global emissions. Four key elements, namely mitigation of climate change by addressing GHG emissions, adaptation to impacts of climate change, issues of financial assistance and technology development and transfer were outlined. 'Deep cuts in global emissions' were recognized as necessary to stall dangerous climate change even though several countries, including the U.S., opposed any specification of the outer-limit of atmospheric concentrations of GHG. The demand of developed countries, particularly the U.S., to include developing countries also in the negotiation for an agreement on mitigation measures for both developed and developing countries got accepted. This was a major victory for the developed countries and a blow for those developing countries who had argued for their right to development, and therefore their due share in the carbon space. This paved the way for the dialogue to move to a negotiation process for long-term cooperative action that now included the developing countries along with the developed ones. This, however, still proved the difficult part. The 'enhanced national/international action on mitigation of climate change' was to include 'measurable, reportable and verifiable nationally appropriate mitigation actions' by both the developed and developing

countries. Some developing countries objected to this as being a negation of the CBDR principle, and the U.S. stiffly opposed a rephrasing of this point proposed by India.¹⁹ This nearly caused the negotiations to break down. The U.S. contended that the phrase ‘measurable, reportable and verifiable’ seemed to apply mainly or only to technology, financing, and so on and not to actual mitigation actions by the developing countries. This was countered by others that technology, financing and capacity building of developing countries by developed countries should also come under the purview of ‘measurable, reportable and verifiable’ mitigation actions. The ambiguity in the language, it was agreed, could be dealt with in subsequent negotiations. Reducing emissions from deforestation and forest degradation (REDD) also entered into the scope of the negotiation, to provide an incentive to developing countries to reduce and avoid deforestation. International and multilateral support for adaptation actions, risk management and risk reduction strategies, disaster reduction strategies and ways to address loss and damages resulting from climate change impacts were also included as other areas to be considered in the negotiations.

Forests and the Climate Change Talks

Controversial mitigation schemes like Reducing Emissions from Deforestation and forest Degradation (REDD) through schemes to protect forests, conservation of forest carbon stocks, sustainable management of forest and, finally, enhancement of forest carbon stocks through a range of conservation measures (which came to be known as REDD+), as well as reducing emissions from all land uses (known as REDD++) owe their origins to the Kyoto Protocol.²⁰ Removal of GHGs by sinks and protection and conservation of forests entered into the negotiation in the CoP 14/CMP 4. The Coalition for Rainforest Nations led by Papua New Guinea, requested an agenda item ‘Reducing emissions from deforestation in developing countries: approaches to stimulate action’ in the CoP 11. The Bali Action Plan included this as part of its action on mitigation of climate change.²¹

The determination of the industrialized countries to not fulfil their Kyoto Protocol commitments became evident during the CoP 15/CMP 5. A long-term binding agreement continued to be elusive.

The principle of historical responsibility for emissions and equity that had formed the core of the negotiations was dumped, instead it was argued that the responsibility of total historical emissions now tilt towards developing countries as the years go by.²² The issue was no longer that of a country's carbon footprint, or who historically contributed to the problem, but of who will do what now. The science-dictated emission reduction consensus was negated. Even the hopes for an extension of the Kyoto Protocol seemed to be fading. But instead a 'political accord' was reached outside the UNFCCC process,²³ where additional resources were promised for forestry and investments through international institutions. Long-term cooperative involvement remained unresolved.

What Next After Kyoto? Folding Up For Another Rewrite

The CoP 16/CMP 6 was able only to reach an agreement at Cancun (Cancun Agreement), acknowledging climate change as a serious issue that requires deep cuts in global greenhouse gas emissions, and accepted the need to establish a low-carbon society. The crucial difference between the developed and developing nations was breached with the developing nations being brought into the ambit of carbon emission capping, which was obviously a step in the right direction. Kyoto now was as good as folded up. In practical terms, all that the CoP could agree upon was the setting up of a 'Green Climate Fund' worth \$100 billion annually by 2020, without as much as detailing it, and establishing a 'Climate Technology Centre' for technology development and transfer, by facilitating a network for this. Earlier in 2009 at Copenhagen, fast-start finance was one of the two commitments made by developed countries; they pledged \$30 billion in new and additional short-term funding for mitigation and adaptation in developing countries for the years 2010 to 2012. The rich countries indicated that they were unwilling to take responsibility to pay for the transition of the rest of the world to low-carbon technologies, pointing to the prevailing global recession and the increasing emission rates of the developing world.

Towards A Legally Binding Agreement

The CoP 17/CMP 7 inaugurated the Durban Platform for Enhanced Action that agreed to produce a legally binding climate agreement applicable to all countries by 2015 ('a Protocol, another legal instrument or agreed outcome with legal force under the Convention applicable to all') and which was to come into effect from 2020. Until this is signed in 2015, it was agreed that the Kyoto Protocol and the carbon trading mechanism it created would remain functional—under pressure from China and India, whose big corporations benefit from carbon trading under the Kyoto Protocol, even as many of their projects continue to affect the poor adversely. This also led to renewed hope among such companies that legally binding emission reduction targets in place by 2020 would boost the carbon trading markets, which had slumped in recent years due to a combination of factors, including an oversupply of carbon credits in the European emissions market, increased delivery risks in the face of dubious CDM projects and the so-called 'recycled CERs' and, most importantly, the global recession (Chestney and Coelho 2011). CDM trading volumes, for instance, slumped by 80 percent from their 2008 peak, and the European Union's carbon credits—which had peaked at over €35/tonne—lingered between €11–14/tonne through 2010–11, finally crashing to €4.4/tonne on 13 December 2011 (Bond 2011). The crash occurred when the initial trends from the Durban meet signalled that there was no immediate prospect of an enforced establishment of global carbon markets.

The Durban meet adopted a management framework for the annual \$100 billion Green Climate Fund. It also laid to rest the notion of common, but differentiated responsibilities with the outright refusal of the industrialized countries to accept primary responsibility for the accumulation of GHG. But where does all this leave actual and direct curtailing of carbon emissions?

Battle Lines Drawn and Redrawn: Geopolitics and Climate Politics

The 27-member European Union (EU), the 39-member Alliance of Small Island Nations (AOSIS) and the 48-member Least Developed

Countries bloc (LDCs)²⁴ had pushed for a positive agreement. On the other hand, China and India, far from exhibiting any Third World solidarity, conspired with the U.S. to thwart the EU. It was the island states, the EU, the LDCs and the African nations who were rebellious. Venezuela along with Cuba, Bolivia and Ecuador, as part of ALBA (the left-leaning Bolivarian Alliance of the Americas), though seen as irritants by others, remained defiant till the end, aggressively arguing for the scientific targets necessary to prevent a global ecological collapse. Brazil, initially a champion on climate change, succumbed to its oil and agribusiness interests, and joined with South Africa, India and China to form the BASIC group, which finally supported the EU proposals at CoP 17. Tuvalu, backed by many of the poorest countries exposed to climate change such as Barbados, the Cook Islands, Fiji and some African nations including Senegal, Sierra Leone and Cape Verde, broke ranks with the G-77 united front of poor nations. The 22-member Arab League, including Palestine, was more worried about whether the climate change agreements would limit their oil-producing income. Meanwhile, new processes have also formed, such as the 'Cartagena Dialogue' (formed in 2010) which includes countries from almost every negotiating group, such as Mexico, Costa Rica, Colombia, Peru, Chile and many others, as well as the more progressive European states such as Denmark, Belgium, Germany, and the UK.²⁵ How these new configurations will play out are yet to be seen.

Outside the UN Process

Outside the UN process, debates have raged, with participants ranging from sceptics (climate change deniers)²⁶ to the dogmatically market oriented non-governmental organizations²⁷ to the progressives²⁸ demanding tough action especially around the idea that rich countries, responsible for most of the historic climate change inducing emissions, owe a debt to the developing world. Environmentalists, while largely ridiculing Kyoto's insignificant reduction targets, however paradoxically maintain that Kyoto is a step in the right direction. Many non-governmental organizations provided technical justifications²⁹ for, or

called for participatory approaches to, carbon dump projects.³⁰ Non-governmental organizations have been nearly as prominent in the development and advocacy of pollution trading as private corporations.³¹

However, many other non-governmental organizations across the world, along with many indigenous community-level groups and social movements, have come out with clear critiques of the ongoing climate negotiations, mainly the so-called market-linked 'climate solutions' (such as carbon trading) that the negotiations produced. Several such groups met in Durban in 2004, and formulated the first politically sophisticated attack on market-linked climate solutions, in what later became known as the Durban Declaration. Subsequently major movement groups such as the La Via Campesina and the MST of Brazil, and important environmental NGOs such as the Friends of the Earth, took similar political positions on the climate issue; and the process led to formation of new international climate alliances like Climate Justice. An important aspect of this somewhat loose and rather unstructured process has been the evident political clarity on certain issues; most groups unequivocally reject all forms of techno-fixes and market-driven solutions, and call for larger people's mobilization in defence of the climate and against neoliberal capitalist invasion of community resources.

In this context, the World People's Conference on Climate Change and the Rights of Mother Earth,³² held from 19 to 22 April 2010 in Bolivia, assumes great significance. The conference was hosted by the Government of Bolivia in response to the failed climate talks in Copenhagen (CoP 15). Countering the corporate grip over the CoP negotiations, the final 10-page declaration adopted at the Conference squarely identifies capitalism as the source of the climate change problem and declares that a new system is required to restore the harmony with nature. The declaration also recognizes the climate debt owed by developed countries to Mother Earth and to the rest of the world. It calls on developed countries to:

- Commit to quantified emission reductions that will limit the global temperature increase to a maximum of 1°C;

- Bear the costs and ensure technology transfer necessary to compensate the developing countries for their lost development opportunities due to a compromised atmosphere; and
- Take responsibility for climate change migrants, through the conclusion of an international agreement.

It also urges the approval of a second commitment period (from 2013 to 2017) under the Kyoto Protocol, in which developed countries should commit to reduce domestic emissions by at least 50 percent against 1990 levels, without resorting to market-based mechanisms. It further calls for the recognition and integration of the UN Declaration on the Rights of Indigenous Peoples in the climate change negotiations. It also rejects a definition of forests that includes plantations and condemns market-based mechanisms, such as reducing emissions from deforestation and forest degradation in developing countries (REDD), inclusion of conservation, sustainable management of forests and stock enhancement in addition to REDD (REDD+), and inclusion of all terrestrial carbon in addition to REDD+ (REDD++), as violating the right to the prior informed consent of indigenous peoples and national sovereignty.³³

The World has Moved On

The two decades since 1990 saw vast changes in the numbers game. Globally the concentration of atmospheric carbon dioxide rose by 2.3 ppmv (parts per million by volume) in 2009–10 (*Times of India* 2010). This was despite the fact that the chaotic economic and political situation in East European countries and the former USSR led to an unforeseen decrease in emissions by some 30 percent in this region during most of the 1990s.

In 2010, carbon dioxide emissions increased by 5.8 percent, as compared to the previous year's decline of 1 percent. In fact, emissions declined in 2008 and 2009 only to rebound in 2010. The industrialized countries, who accounted for 70 percent of the global annual emissions in 1990, had a lower share of 43 percent in 2010,³⁴

not because they had reduced their absolute emissions—in fact they increased their emissions—but because the new high growth countries increased their emissions much more rapidly (Narain 2011). China, for instance, increased its per capita emissions from 2.2 tonnes of carbon dioxide in 1990 to 6.8 tonnes in 2010, a 205 percent increase, while India almost doubled its per capita emission from 0.8 to 1.5 tonnes during the period. In comparison, per capita emissions in the U.S. declined by 14 percent—from 19.7 to 16.9 tonnes (Olivier et al. 2011). India became the world's fifth biggest emitter (after China, the U.S., Europe and Russia) in 2007 (Watts 2010), with an increase of 58 percent in its GHG emissions since 1994. Between the years 2009 and 2010, while China increased its emissions by 10.37 percent, India increased its emissions by 8.98 percent, as compared to USA's increase of 4 percent, Germany's and the UK's increase of 4 percent and the EU-15's increase of 2.84 percent. In absolute terms, however, the U.S. increase of 4 percent was greater than India's increase of 8.98 percent by about 0.5 billion tonnes of carbon dioxide.

Canada, Japan and Russia declared that they would not accept new Kyoto commitments in 2010. Canada followed this up by withdrawing from the Kyoto Protocol on the eve of CoP 17 in 2011, saying that the Protocol did not cover the U.S. and China, the world's largest emitters. The U.S. wanted binding targets to be applied to the emerging economies too, as their emissions have risen steadily since Kyoto.

2.4 The Climate Talks in Retrospect

While the Kyoto Protocol and intergovernmental negotiations leading up to it recognized the need for immediate measures to tackle global warming induced climate change, the process failed to achieve any significant and tangible reduction in global green house gas emissions. Right from the beginning, the U.S. and a few others were strongly opposed to the very idea of binding emission reduction targets. Instead, it was agreed that emissions levels would be calculated and reported annually.

The Kyoto Protocol introduced the CBDR principle in emissions reduction, depending upon their share in the total global emissions. This required the developed nations to act first. Though the European countries included in Annex I of the Kyoto Protocol in principle agreed to this CBDR formula, several 'developed' nations, like the USA and Australia, self-exempted themselves, citing their economic growth imperatives, and then demanded that 'developing' market economies like India and China must announce specific and time-bound emission reduction targets. Thus the premise of CBDR on which the Kyoto Protocol stood was rendered shaky from the very beginning, and the climate negotiations got mired in the economic interests of some of the richest nations.

It was conveniently forgotten that colonial and neocolonial exploitation³⁵ of natural resources and ecosystem communities in the so-called global South by predator economies in the global North not only defined the relationships between the developed countries and the rest of the world, but also made possible the very 'development' that resulted in higher levels of emissions in the developed countries and underdevelopment in the rest. In addition, the lesser capacity of the poorer countries to adapt to climate change impacts is yet another outcome of this very unequal and unjust relationship. Therefore, the liability to reduce emissions, as well as to assist the emerging economies and the non-industrialized countries to cope with the impacts and better manage their own emission levels, should squarely have been with the industrialized countries.

Whither Climate Change Response: The Grotesque Reality of Carbon Trading

A look at the Kyoto Protocol makes it clear that the point of the whole exercise was never anything but maintaining the status quo: instead of fixing measurable, tangible and real emission reduction targets, it talks in complex jargon about several 'baselines' for counting emissions, 'removal by sinks' (meaning trapping or storing atmospheric carbon or other greenhouse gases in forests, plantations, oceans or

soil, known as 'carbon sinks'), and 'emissions exchange' (meaning that one unit of emission reduced anywhere in the globe cancels another unit of emission generated somewhere else). At the same time, there is increasing recognition of climate change impacts, and particularly its economic fallout.

The industrialized countries included in Annex I of the Kyoto Protocol not only succeeded in maintaining the status quo, but also arm twisted others into establishing a market-based response in the form of a range of marketable packages (such as CDM, REDD, REDD+ and REDD++), rather than any actual solution to global warming. Such trading later became known as emissions trading, or more commonly, carbon trading. The governments of the emerging economies and those of the poorer countries colluded in setting the terms of trade. Even though industrialized countries like USA did not become a party to the Kyoto Protocol, they readily embraced these market-driven 'solutions.' After the launch of the UNFCCC in 1992, the initial period was used for testing the waters for the viability of carbon market and gauging investor interest. In subsequent CoPs leading up to the most recent CoP 17 in Durban, this trade became the most visible aspect of the climate negotiations.

The Kyoto Protocol and the cap on emissions by the industrialized countries it called for therefore became instruments of a 'global carbon market' that emerged in its wake. The UNFCCC became the nodal agency to monitor the trading, which came to be dominated entirely by big corporations in both North and South, and a host of largely unregulated market forces. Later in this study we will see how some of the largest corporations in a country like India continue to profit from the carbon business at great social and environmental costs. Similar unrestricted profiteering has been reported from all over the world where carbon trading projects are happening.

As has been pointed out time and again (Lohmann 2006, 2011, 2012; and Coelho 2009), the ideas of 'emissions exchange' and 'removal by sinks' supplied the industrial civilization in the global North with ready excuses for prolonging the energy-intensive, capital-intensive, highly inequitable and exploitative model of economic

development that it had practised for long, and had exported successfully to the 'emerging economies' in the South. The typical neoliberal faith in the market economy strengthened the concept and lent it teeth. At a time when the very notion of markets as we know, is under threat because of the continuing economic recession, and carbon trading has been exposed for what it is—a colossal fraud, it is surely time to question the process that has turned the greatest crisis humanity has ever faced into an unscrupulous 'market,' subject to all the usual speculative activity.

At the core of the carbon trading process lies the claim that emissions are, in essence, exchangeable commodities, which can be assessed, priced and traded through market negotiations. Another concurrent belief was that the industrially developed countries have an innate right to dump part of their emissions into the world's forests, oceans and land, to the exclusion of countries and people who are not similarly 'developed' and, therefore, do not need to emit so much. Because industrial development in a capitalist and market-based economic system is controlled and managed by large private corporations, this in reality translates into the right of big corporations to continue with their current levels of production, using economically advantageous production techniques, even if it means sustaining their current levels of emissions. The reality that the earth's atmosphere already contains more carbon dioxide and other GHGs than it can reasonably store, and that global warming induced climate change exists and is real thus, in fact, gets nullified.

The concept of carbon trading is based on the dangerous myth that emissions reduction can happen without any reduction of the source of emissions. In other words, corporations responsible for large quantities of emissions will not desist from their business-as-usual practice of burning fossil fuels, and the following claims will be cited to justify their actions:

1. Reduction of emissions makes for poor economic sense and impair growth,

2. These companies have a legitimate right to emit, and
3. It is cheaper and more rational to pay someone else to reduce 'their' emissions, because all 'emissions' are born equal and reductions can 'offset' increases.

The results of the market-centric pseudo-scientific fixes that gained currency in the carbon offset regime have expectedly been disastrous. The often hegemonic and unjust relationship amongst nations and communities worsens both because of the climate crisis and because of its 'solutions'—in particular, the lure of easy money to be had from various types of carbon trading. This has led to more intense and widespread resource-grab and privatization of commons, which in turn has badly affected those already threatened by unprecedented climate disasters.

2.5 India and the UNFCC

The Argument for Carbon Equity

India's apprehension is that the industrialized countries will insist on emission caps being made applicable to emerging economies as well. This is not unfounded, because India's emission rates are rising every year.³⁶ To address this potential threat, India took the official position that meaningful negotiations are not possible without addressing issues of equity. It argued that industrialized countries have historically contributed the majority of the existing stock of anthropogenic GHGs, and hence the burden of mitigation cannot be placed on poorer countries. It also routinely pointed out that the per capita rates of emissions in developed economies are far higher than those of poorer countries such as India, and therefore restraints on emission in poorer countries are simply not acceptable, as this would actually mean denial of developmental rights and curtailing of poverty eradication, thereby forcing the country to remain in poverty. India's strategy has always been to insist on equity as the basis for sharing the right to emit GHGs. A good example of this

approach is the statement of the Minister for Environment and Forests at Durban:

We are talking of livelihoods and sustainability here. How do I give a blank cheque, to sign away the rights of 1.2 billion people of India without even knowing what this legally binding agreement is? Where will equity and CBDR figure in this agreement?

I am not doubting any one's sincerity. But, does fighting climate change mean we have to give up on equity? We must have equity and CBDR in the options.³⁷

India put forward the principle that long-term convergence of per capita emissions is 'the only equitable basis for a global compact on climate change.' It argued that all countries should move, over a period of time, to reach the same per capita emission levels. This position, India argued, would ensure efficiency, equity and social inclusion. It stressed on a medium and long term target and time frame based on the above, including deep cuts (more than 25–40 percent) by Annex I countries prior to 2020, as they had increased their emissions during the period after Kyoto.³⁸ The agenda should go beyond mere setting of targets for capping emissions by rich countries to a comprehensive adaptation package for poor countries that would assist them in pursuing their growth agenda. India insisted on transfer and diffusion of technologies from developed countries to the developing world under the UNFCCC, which would include

- Full costs of procuring technology,
- Guarantee of foreign direct investment (FDI) for necessary technologies,
- Global public investment to leverage a market for new technologies,
- Coverage of costs of compulsory licensing and other intellectual property rights (IPR) costs, and
- All funding and technology issues to be handled through the UN treaty mechanism and not through the World Bank or other agencies.

India insisted upon an adaptation fund, which was to include a contribution of 0.5 percent GDP by all rich countries for poor countries. It pushed for guarantees for 'equitable access to sustainable development' in the Cancun agreements, along with 'international assessment and review' of developed country actions on development and transfer of technology (Varad 2011). In order to reassure other parties that it is not averse to negotiations and is not indifferent to climate change, India also announced that

- It 'will reduce the emissions intensity of India's GDP by 20–25 percent by the year 2020, based on a 2005 reference level,'³⁹
- Diversify its energy-fuel mix,
- Launch aggressive strategies on forestry and coastal management,
- Set up an 'elaborate Indian Network for Comprehensive Climate Change Assessment,' and
- Establish a partnership with 'neighbours and other countries to deal with climate change.'⁴⁰

India also committed to not allowing the country's per capita emissions to rise above the per capita emissions of the advanced countries.

Equity That is Fundamentally Inequitable

However, India's position is obviously not a principled position, because such arguments remain reserved for inter-country arguments, while remaining entirely ignored at the intra-country level. Equity between nations using averages, hides the vast inequity within nations, which is particularly vivid in India and some other countries. Inside the country, issues of equity, social inclusion and social justice have been treated as irrelevant; and therefore they continue to confound the growth and development process that India has been pursuing, particularly in the post-liberalization era, despite constitutional provisions and laws regarding distributive justice. Numerous

official planning documents reflect this dismal picture (Planning Commission 2008). Moreover, the highly iniquitous treatment of the overwhelming majority of India's people by the country's successive governments spreads and intensifies disaffection; this is particularly the case when the government engages in public and deliberately disregard its own laws and denies legally enforceable rights (GoI 2008). Therefore, for the Indian state to passionately take refuge behind the '*the rights of 1.2 billion people of India*' and their right to equitable carbon emissions rings hollow.

Further, the principle of 'long-term convergence of per capita emissions' that India has been championing is fundamentally flawed. Neither all large countries are poor, nor are all small countries rich. As a result, per capita allocation in practice gives differential emission rights and benefits, throwing the principle of equity to the winds. Though India could benefit, the benefit will actually accrue to the rich at the cost of the poor; similarly, some poorer countries with small populations will lose, while some rich but populous countries would gain. Per capita allocation does not take care of the differential impacts of emissions, as countries like India are likely to suffer more from global warming. There is also no guarantee that transferred wealth in the form of emission rights to the government will be fairly distributed within the countries thus benefited, especially if the country follows or promotes a skewed growth agenda or is mired in corruption, as is the case with India. Instead, an approach that is openly redistributive is better than a per capita allocation (Harris 2003).

India initially argued that the South had no responsibility and that the 'opulent lifestyles' of the people of the North and their per capita emissions were the primary causes for climate change. It therefore held that the negotiations should lead to developed country commitments, including quantified limitation and reduction objectives, with specified time-frames, policies and measures for achieving them. Further, no new commitments for developing countries were to be introduced.⁴¹ India had rejected New Zealand's proposal that required developing countries to cut their emissions by 2014, and also refused to accept voluntary targets, or set a date for the creation

of targets. Instead, it insisted on its right to increase GHG emissions for the sake of uplifting its poor.

This position, however, dissolved into double-speak when, in 2005, India teamed up with the U.S. and Australia, the two main antagonists of the Kyoto Protocol, along with Japan, South Korea and China, to form the Asia-Pacific Partnership for Clean Development and Climate⁴², with Canada (who withdrew from Kyoto Protocol subsequently in 2011) joining in 2007. Essentially a public-private partnership, the group rejected mandatory emission reduction of GHGs, and instead decided to focus on technological solutions in eight identified industrial sectors.⁴³ The formation of this group was interpreted widely as an attempt to scuttle Kyoto agreement, though the group's stated goal was to 'complement, but not replace the Kyoto Protocol.' It is also a matter of valid concern to many that this partnership paves the way for the emerging largest developing country GHG emitters—China and India—to gang up with the opponents of any mandatory emission commitments in the post-Kyoto phase.

Profiting from Kyoto

Though India was initially not enthusiastic about Kyoto, the government soon realized that the Protocol made good economic sense (Gupta, S. 2002). Nearly all climate change related policy documents of the Indian government showcase the country's rich CDM kitty, and Indian corporations and their associations follow suit; carbon trading and the new climate business that has begun in its wake, are extremely popular with Indian business people.⁴⁴ India took the lead in Bali to discuss emission reduction from deforestation and degradation in a 'holistic' manner (REDD+), as well as the creation of a national level mechanism through which incentives to preserve standing forests could be received. Going further, India proposed to include restriction of deforestation, conservation efforts and sustainable forest management within the REDD discussion and argued that such efforts should also be 'financially rewarded' (Dubash 2007).

Ever since the Kyoto Protocol, India had maintained that it was not for negotiating a new climate treaty, even when it became abundantly clear that the Annex I countries would simply ignore their emission reduction targets instead of meeting them (Gupta, J. 2009). At Durban, India again posed 'equity as a fundamental issue wherein eradication of poverty and social and economic development' is 'the primary goal' and reiterated that 'since the per capita emission is small in countries as India,' such countries 'cannot be expected to be legally bound to reduce their emissions.' The Green Climate Fund should be established with resources from developed countries.⁴⁵ Ironically, what emerged was an agreement to start talking on a new climate treaty, which India whole heartedly acceded to (reversing its stated position against a new treaty); the new agreement would bind all countries with targets and mandate the setting up of the Green Climate Fund. What was important to Indian negotiators was that the carbon market would continue to exist, and that India could indeed be one of the top investment destinations once the 'legally binding' new treaty comes up. India has already announced an ambitious National Mission for A Green India under the National Action Plan on Climate Change (MoEF 2010), and has started its own domestic carbon trading in form of Renewable Energy Trading. All this is being done in anticipation of a bonanza.

India's Climate Politics: Need for a Re-look

The logic the Indian government so far has been using in rationalizing its energy-intensive, and hence predominantly fossil-fuel-intensive development/growth trajectory, consists of two premises: first, poverty alleviation in tune with the Millennium Development Goals; and second, democratization of the carbon space. While the next chapters will demonstrate how India's economic growth in fact dispossesses and disempowers the country's poor, the second point is more problematic, as it appears logical, based on the binary of us/them and our right-to-grow/right-to-emit formula, as opposed to the industrialized countries' historical contribution to the global emission curve.

But this too is untrue if one examines the direct link between the democratic-sounding and apparently politically correct ‘right-to-grow/right-to-emit’ rhetoric and the impacts of the increasing growth-emission curve on the poor and marginalized. It is easily shown (see the later chapters of this study) that India’s growing share in the carbon space—and hence, India’s interpretation of ‘equity’ and CBDR—is linked to processes that will result in more social and environmental disasters inside the country: for instance the new spurt in integrated power projects, ultra mega thermal projects, hydro-electric dams and coal mines. These can only mean more dispossession, more deforestation and hence more poverty, while also increasing emissions.

The government’s position on adaptation and mitigation, including the open promotion of all forms of carbon trading, also does not stand scrutiny. It can be shown (see later chapters) that for the Indian people these add to the prevailing misery, and only the state and the corporations benefit. Even a cursory review of the so-called alternative energy practices will show that the large corporations control both the mainstream and alternative energy systems⁴⁶ wind, solar, hydro, biomass, waste-to-energy and so on.

In sum, not much is being done to reduce the vulnerability of people. Climate change impacts already have a severe impact on communities along the coasts, mountains and inland agricultural areas: frequent droughts, changes in the monsoon cycle and crop production cycles affected. Ironically, the Indian people are victims three times over: of climate change/global warming caused by the industrially developed countries, of India’s carbon space democracy politics as manifested in ‘development’ disasters and struggles, and most distressingly, of mitigation policies and actions as well.

The question needs to be raised as to what ‘carbon equity’ means for the victims of climate change, because India’s utilization of its just share of ‘carbon space’ evidently translates into more aggressively enclosing the remaining commons on which people’s lives and livelihoods depend. The resource-guzzling growth trajectory needs to be forsaken not only because of increased emissions but, very much also

because the process is inequitable, unethical, unjust and unconstitutional in a purely domestic context, and also therefore uneconomical in the long term.

Notes

1. Signed by 154 countries.
2. As of May 2011.
3. Principle 7 of the Rio Declaration provides the first formulation of the CBDR principle, stating thus: 'In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.'
4. The Kyoto Protocol to The United Nations Framework Convention on Climate Change is available at <http://unfccc.int/resource/docs/convkp/kpeng.pdf>. 193 Parties (192 States and 1 regional economic integration organization) as on January 2012 adopted the Protocol; See *Status of Ratification of the Kyoto Protocol* at http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php.

The U.S., though a signatory, has not ratified it. Afghanistan, Andorra and South Sudan are the other countries yet to ratify Kyoto.

5. *Article 3*
 1. The Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B and in accordance with the provisions of this Article, with a view to reducing their overall emissions of such gases by at least 5 percent below 1990 levels in the commitment period 2008 to 2012.
 2. Each Party included in Annex I shall, by 2005, have made demonstrable progress in achieving its commitments under this Protocol.
 3. The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex I. The greenhouse gas emissions by sources and removals by sinks associated with those activities shall be reported in a transparent and verifiable manner and reviewed in accordance with Articles 7 and 8.

4. Prior to the first session of the Conference of the Parties serving as the meeting of the Parties to this Protocol, each Party included in Annex I shall provide, for consideration by the Subsidiary Body for Scientific and Technological Advice, data to establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes in carbon stocks in subsequent years. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session or as soon as practicable thereafter, decide upon modalities, rules and guidelines as to how, and which, additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties included in Annex I, taking into account uncertainties, transparency in reporting, verifiability, the methodological work of the Intergovernmental Panel on Climate Change, the advice provided by the Subsidiary Body for Scientific and Technological Advice in accordance with Article 5 and the decisions of the Conference of the Parties. Such a decision shall apply in the second and subsequent commitment periods. A Party may choose to apply such a decision on these additional human-induced activities for its first commitment period, provided that these activities have taken place since 1990.
5. The Parties included in Annex I undergoing the process of transition to a market economy whose base year or period was established pursuant to decision 9/CP.2 of the Conference of the Parties at its second session shall use that base year or period for the implementation of their commitments under this Article. Any other Party included in Annex I undergoing the process of transition to a market economy which has not yet submitted its first national communication under Article 12 of the Convention may also notify the Conference of the Parties serving as the meeting of the Parties to this Protocol that it intends to use an historical base year or period other than 1990 for the implementation of its commitments under this Article. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall decide on the acceptance of such notification.
6. Taking into account Article 4, paragraph 6, of the Convention, in the implementation of their commitments under this Protocol other than those under this Article, a certain degree of flexibility shall be allowed by the Conference of the Parties serving as the meeting of the Parties to this Protocol to the Parties included in Annex I undergoing the process of transition to a market economy.
7. In the first quantified emission limitation and reduction commitment period, from 2008 to 2012, the assigned amount for each Party included in Annex I shall be equal to the percentage inscribed for it in Annex B of its aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A in 1990, or the base year or period

determined in accordance with paragraph 5 above, multiplied by five. Those Parties included in Annex I for whom land-use change and forestry constituted a net source of greenhouse gas emissions in 1990 shall include in their 1990 emissions base year or period the aggregate anthropogenic carbon dioxide equivalent emissions by sources minus removals by sinks in 1990 from land-use change for the purposes of calculating their assigned amount.

8. Any Party included in Annex I may use 1995 as its base year for hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, for the purposes of the calculation referred to in paragraph 7 above.
9. Commitments for subsequent periods for Parties included in Annex I shall be established in amendments to Annex B to this Protocol, which shall be adopted in accordance with the provisions of Article 21, paragraph 7. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall initiate the consideration of such commitments at least seven years before the end of the first commitment period referred to in paragraph 1 above.
10. Any emission reduction units, or any part of an assigned amount, which a Party acquires from another Party in accordance with the provisions of Article 6 or of Article 17 shall be added to the assigned amount for the acquiring Party.
11. Any emission reduction units, or any part of an assigned amount, which a Party transfers to another Party in accordance with the provisions of Article 6 or of Article 17 shall be subtracted from the assigned amount for the transferring Party.
12. Any certified emission reductions which a Party acquires from another Party in accordance with the provisions of Article 12 shall be added to the assigned amount for the acquiring Party.
13. If the emissions of a Party included in Annex I in a commitment period are less than its assigned amount under this Article, this difference shall, on request of that Party, be added to the assigned amount for that Party for subsequent commitment periods.
14. Each Party included in Annex I shall strive to implement the commitments mentioned in paragraph 1 above in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention. In line with relevant decisions of the Conference of the Parties on the implementation of those paragraphs, the Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session, consider what actions are necessary to minimize the adverse effects of climate change and/or the impacts of response measures on Parties referred to in those paragraphs. Among the issues to be considered shall be the establishment of funding, insurance and transfer of technology.

6. The six gases covered are carbon dioxide (CO₂), the most pervasive in human activity, methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆).
7. Forty-two industrialized countries and economies in transition.
8. It set 8 percent emission reduction target for European Union and others, 6 percent for Japan, 0 percent for Russia and 7 percent for the U.S. (though the U.S. did not ratify the Protocol). Emissions increases for Australia and Iceland were permitted at 6 percent and 10 percent respectively.
9. *Article 5*
 1. Each Party included in Annex I shall have in place, no later than one year prior to the start of the first commitment period, a national system for the estimation of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. Guidelines for such national systems, which shall incorporate the methodologies specified in paragraph 2 below, shall be decided upon by the Conference of the Parties serving as the meeting of the Parties to this Protocol at its first session.
 2. Methodologies for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties at its third session. Where such methodologies are not used, appropriate adjustments shall be applied according to methodologies agreed upon by the Conference of the Parties serving as the meeting of the Parties to this Protocol at its first session. Based on the work of, inter alia, the Intergovernmental Panel on Climate Change and advice provided by the Subsidiary Body for Scientific and Technological Advice, the Conference of the Parties serving as the meeting of the Parties to this Protocol shall regularly review and, as appropriate, revise such methodologies and adjustments, taking fully into account any relevant decisions by the Conference of the Parties. Any revision to methodologies or adjustments shall be used only for the purposes of ascertaining compliance with commitments under Article 3 in respect of any commitment period adopted subsequent to that revision.
 3. The global warming potentials used to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of greenhouse gases listed in Annex A shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties at its third session. Based on the work of, inter alia, the Intergovernmental Panel on Climate Change and advice provided by the Subsidiary Body for Scientific and Technological Advice, the Conference of the Parties serving as the meeting of the Parties to this Protocol shall regularly review and, as appropriate, revise

the global warming potential of each such greenhouse gas, taking fully into account any relevant decisions by the Conference of the Parties. Any revision to a global warming potential shall apply only to commitments under Article 3 in respect of any commitment period adopted subsequent to that revision.

10. *Article 10*

All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, without introducing any new commitments for Parties not included in Annex I, but reaffirming existing commitments under Article 4, paragraph 1, of the Convention, and continuing to advance the implementation of these commitments in order to achieve sustainable development, taking into account Article 4, paragraphs 3, 5 and 7, of the Convention, shall:

- (a) Formulate, where relevant and to the extent possible, cost-effective national and, where appropriate, regional programmes to improve the quality of local emission factors, activity data and/or models which reflect the socio-economic conditions of each Party for the preparation and periodic updating of national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties, and consistent with the guidelines for the preparation of national communications adopted by the Conference of the Parties;
- (b) Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change:
 - i) Such programmes would, inter alia, concern the energy, transport and industry sectors as well as agriculture, forestry and waste management. Furthermore, adaptation technologies and methods for improving spatial planning would improve adaptation to climate change; and
 - ii) Parties included in Annex I shall submit information on action under this Protocol, including national programmes, in accordance with Article 7; and other Parties shall seek to include in their national communications, as appropriate, information on programmes which contain measures that the Party believes contribute to addressing climate change and its adverse impacts, including the abatement of increases in greenhouse gas emissions, and enhancement of and removals by sinks, capacity building and adaptation measures;
- (c) Cooperate in the promotion of effective modalities for the development, application and diffusion of, and take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to,

environmentally sound technologies, know-how, practices and processes pertinent to climate change, in particular to developing countries, including the formulation of policies and programmes for the effective transfer of environmentally sound technologies that are publicly owned or in the public domain and the creation of an enabling environment for the private sector, to promote and enhance the transfer of, and access to, environmentally sound technologies;

- (d) Cooperate in scientific and technical research and promote the maintenance and the development of systematic observation systems and development of data archives to reduce uncertainties related to the climate system, the adverse impacts of climate change and the economic and social consequences of various response strategies, and promote the development and strengthening of endogenous capacities and capabilities to participate in international and intergovernmental efforts, programmes and networks on research and systematic observation, taking into account Article 5 of the Convention;
 - (e) Cooperate in and promote at the international level, and, where appropriate, using existing bodies, the development and implementation of education and training programmes, including the strengthening of national capacity building, in particular human and institutional capacities and the exchange or secondment of personnel to train experts in this field, in particular for developing countries, and facilitate at the national level public awareness of, and public access to information on, climate change. Suitable modalities should be developed to implement these activities through the relevant bodies of the Convention, taking into account Article 6 of the Convention;
 - (f) Include in their national communications information on programmes and activities undertaken pursuant to this Article in accordance with relevant decisions of the Conference of the Parties; and
 - (g) Give full consideration, in implementing the commitments under this Article, to Article 4, paragraph 8, of the Convention.
11. Article 2(a)(iv) Research on, and promotion, development and increased use of, new and renewable forms of energy, of carbon dioxide sequestration technologies and of advanced and innovative environmentally sound technologies.
12. *Article 7*
- 1. Each Party included in Annex I shall incorporate in its annual inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol, submitted in accordance with the relevant decisions of the Conference of the Parties, the necessary supplementary information for the purposes of ensuring compliance with Article 3, to be determined in accordance with paragraph 4 below.
 - 2. Each Party included in Annex I shall incorporate in its national communication, submitted under Article 12 of the Convention, the

supplementary information necessary to demonstrate compliance with its commitments under this Protocol, to be determined in accordance with paragraph 4 below.

3. Each Party included in Annex I shall submit the information required under paragraph 1 above annually, beginning with the first inventory due under the Convention for the first year of the commitment period after this Protocol has entered into force for that Party. Each such Party shall submit the information required under paragraph 2 above as part of the first national communication due under the Convention after this Protocol has entered into force for it and after the adoption of guidelines as provided for in paragraph 4 below. The frequency of subsequent submission of information required under this Article shall be determined by the Conference of the Parties serving as the meeting of the Parties to this Protocol, taking into account any timetable for the submission of national communications decided upon by the Conference of the Parties.
4. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall adopt at its first session, and review periodically thereafter, guidelines for the preparation of the information required under this Article, taking into account guidelines for the preparation of national communications by Parties included in Annex I adopted by the Conference of the Parties. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall also, prior to the first commitment period, decide upon modalities for the accounting of assigned amounts.

13. *Article 12*

1. A clean development mechanism is hereby defined.
2. The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article.
3. Under the clean development mechanism:
 - (a) Parties not included in Annex I will benefit from project activities resulting in certified emission reductions; and
 - (b) Parties included in Annex I may use the certified emission reductions accruing from such project activities to contribute to compliance with part of their quantified emission limitation and reduction commitments under Article 3, as determined by the Conference of the Parties serving as the meeting of the Parties to this Protocol.
4. The clean development mechanism shall be subject to the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to this Protocol and be supervised by an executive board of the clean development mechanism.

5. Emission reductions resulting from each project activity shall be certified by operational entities to be designated by the Conference of the Parties serving as the meeting of the Parties to this Protocol, on the basis of:
 - (a) Voluntary participation approved by each Party involved;
 - (b) Real, measurable, and long-term benefits related to the mitigation of climate change; and
 - (c) Reductions in emissions that are additional to any that would occur in the absence of the certified project activity.
 6. The clean development mechanism shall assist in arranging funding of certified project activities as necessary.
 7. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session, elaborate modalities and procedures with the objective of ensuring transparency, efficiency and accountability through independent auditing and verification of project activities.
 8. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall ensure that a share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
 9. Participation under the clean development mechanism, including in activities mentioned in paragraph 3(a) above and in the acquisition of certified emission reductions, may involve private and/or public entities, and is to be subject to whatever guidance may be provided by the executive board of the clean development mechanism.
 10. Certified emission reductions obtained during the period from the year 2000 up to the beginning of the first commitment period can be used to assist in achieving compliance in the first commitment period.
14. *Article 6*
1. For the purpose of meeting its commitments under Article 3, any Party included in Annex I may transfer to, or acquire from, any other such Party emission reduction units resulting from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of greenhouse gases in any sector of the economy, provided that:
 - (a) Any such project has the approval of the Parties involved;
 - (b) Any such project provides a reduction in emissions by sources, or an enhancement of removals by sinks, that is additional to any that would otherwise occur;
 - (c) It does not acquire any emission reduction units if it is not in compliance with its obligations under Articles 5 and 7; and
 - (d) The acquisition of emission reduction units shall be supplemental to domestic actions for the purposes of meeting commitments under Article 3.

2. The Conference of the Parties serving as the meeting of the Parties to this Protocol may, at its first session or as soon as practicable thereafter, further elaborate guidelines for the implementation of this Article, including for verification and reporting.
3. A Party included in Annex I may authorize legal entities to participate, under its responsibility, in actions leading to the generation, transfer or acquisition under this Article of emission reduction units.
4. If a question of implementation by a Party included in Annex I of the requirements referred to in this Article is identified in accordance with the relevant provisions of Article 8, transfers and acquisitions of emission reduction units may continue to be made after the question has been identified, provided that any such units may not be used by a Party to meet its commitments under Article 3 until any issue of compliance is resolved.
15. The Compliance Committee consists of a plenary, an operational bureau and two branches, namely the Facilitative Branch (to provide advice, assistance and early warnings concerning non-compliance), and the Enforcement Branch (applying consequences when the Parties do not meet their commitments).
16. The U.S. Congress had refused to ratify the treaty that President Bill Clinton had signed, objecting to the absence of any mandatory obligations for developing countries. The Bush administration categorically rejected the Protocol in 2001 while announcing voluntary actions to reduce the 'greenhouse gas intensity' of the U.S. economy by 18 percent over the next decade.
17. The annual meeting since the Kyoto Protocol came into force in 2005 is now the CoP combined with a 'meeting of the parties (CMP);' hence these meetings are referred to as CoP/CMP meetings.
18. For the full text of the Bali Action Plan, see http://unfccc.int/key_documents/bali_road_map/items/6447.php.
19. Originally this text was 'measurable, reportable and verifiable nationally appropriate mitigation actions by developing country parties in the context of sustainable development, supported and enabled by technology, financing and capacity building' (Document FCCC/CP/2007/L.7 circulated on 15 December 2007). This was changed to 'Nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity building, in a measurable, reportable and verifiable manner.'
20. Article.3.2: Net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex I. The greenhouse gas emissions by sources and removals by sinks associated with those activities shall be reported in a transparent and verifiable manner.

21. Report of the Conference of the Parties on its 13th session, held in Bali from 3 to 15 December 2007, Decision 1/CP.13 Para 1 (b) (iii): 'Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.' Available at <http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf>.
22. While 75 percent of the historical greenhouse gases were emitted by industrialized countries, over 50 percent of emissions that are now being added to the atmosphere are by the developing countries.
23. Reached by 20 countries, including the U.S. and BASIC countries (Brazil, South Africa, India and China), this accord also negated the established UN decision making mechanism.
24. Comprising drought-prone states such as Mali and Ethiopia, coastal nations such as Tanzania and Bangladesh and countries worried about disappearing glaciers such as Nepal and Bhutan.
25. For a brief account of the role of the various blocs in the climate talks see for instance, 'Time for A New Geopolitical Climate Bloc.' Part 1, *Aljazeera*, 12 December 2011, and 'Time for A New Geopolitical Climate Bloc. Part 2', *Aljazeera*, 15 December 2011, available at <http://www.aljazeera.com/indepth/opinion/2011/12/2011121213124688507.html> and <http://www.aljazeera.com/indepth/opinion/2011/12/2011121393718974204.html> respectively.
26. For instance the Global Climate Coalition, created by Exxon-Mobil in 1989, aimed at a multimillion-dollar disinformation campaign attacking the notion of climate change; this was dismantled in 2002; also see http://en.wikipedia.org/wiki/Climate_change_denial.
27. The U.S. Climate Action Partnership (USCAP), incorporating big polluters like General Electric, General Motors, BP America, Dow Chemical, Duke Energy, Ford, Dupont and Rio Tinto, and the NGOs Environmental Defense Fund (EDF), Natural Resources Defense Council (NRDC), The Nature Conservancy and World Resources Institute (WRI); as quoted in Coelho (2009).
28. For instance International Forum of Indigenous Peoples on Climate Change, Durban Group for Climate Justice (See <http://www.durbanclimatejustice.org/>), The Corner House, a UK-based NGO (see <http://www.thecornerhouse.org.uk>) and Climate Action Network (see <http://www.climateactionnetwork.org/>).
29. Such as the Nature Conservancy and Environmental Defense Fund.
30. Such as the Climate Action Network in the U.S.
31. The U.S.-based Environmental Defence Fund pushed for its inclusion in Kyoto while the World Resources Institute, World Business Council for Sustainable Development, World Wide Fund for Nature (WWF) (which developed an eco-label for the CDM projects), Greenpeace, Climate Action Network and many others supported the carbon market. See Lohmann (2006).

32. Attended by around 30,000 people from over 100 countries.
33. Quoted from 'People's World Conference on Climate Change Adopts Declaration' available at <http://climate-liisd.org/news/peoples-world-conference-on-climate-change-adopts-declaration/>.
34. OECD countries which had 65.8 percent share of global CO₂ emissions in 1973, came down to 43 percent in 2008.
35. Corporations in rich countries outsource production to countries such as India and China to take advantage of lower wages, cheaper raw materials, weaker environmental regulation, pliable governments and weak enforcement of laws. In this process, the carbon emissions too are outsourced or externalized.
36. India emitted 908 million tonnes of CO₂ in 1998, 4 percent of the world's total. The rate of growth of GHG emissions is 4.6 percent annually as compared to a 2 percent world average. However, its per capita emissions were 0.93 MT per annum, well below the world average of 3.87 MT per annum. See Watts (2010).
37. From the MoEF statement/CoP-MoP plenary/11.12.11 available at http://moef.nic.in/downloads/public-information/MEF%20statement_CoP%20MoP%20Plenary_11.12.11.pdf.
38. Government of India Submission to UNFCCC on Long Term Co-operative Action available at http://unfccc.int/files/kyoto_protocol/application/pdf/indiasharedvisionv2.pdf.
39. Also see 'Communication to the Executive Secretary, UNFCCC' dated 30 January 2010, by Rajani Ranjan Rashmi, Joint Secretary, MoEF available at http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/indiacphaccord_app2.pdf.
40. Speech by Jairam Ramesh, Minister for Environment and Forest, India and Leader of Indian Delegation delivered at Cancun in the Conference of Parties to the UNFCCC (CoP 16) available at http://unfccc.int/files/meetings/cop_16/statements/application/pdf/101209_cop16_hls_india.pdf.
41. 'Green Paper' of India at CoP 1 that led to the Berlin Mandate.
42. For details see *Asia-Pacific Partnership on Clean Development and Climate* available at http://en.wikipedia.org/wiki/Asia-Pacific_Partnership_on_Clean_Development_and_Climate#Criticism.
43. Namely cleaner fossil energy, renewable energy and distributed generation, power generation and transmission, steel, aluminium, cement, coal mining, and buildings and appliances.
44. For instance, Federation of Indian Chamber of Commerce and Industry constituted an FICCI Climate Change Task Force headed by the Former Secretary of the Ministry of Environment and Forests, Government of India, Dr. Prodipto Ghosh and organizes annually the India Carbon Market Conclave, see <http://www.indiacarbonconclave.com/icmc/about-the-conclave.htm>. The

Confederation of Indian Industry constituted a Climate Change Council chaired by Jamshyd Godrej, Chairman and Managing Director of Godrej & Boyce Manufacturing Co. Ltd. According to them 'As India reduces emission intensity of its economy by 20–25 percent by 2020, numerous investment opportunities are likely to emerge in the key sectors. These include (a) Industrial energy efficiency: An investment opportunity of ₹82,575 million, exist in industrial energy efficiency leading to annual saving potential of ₹37,510 million (b) Renewable energy: 20,000 MW target of solar energy capacity by 2022 and pipeline of other renewable energy projects such as biomass, wind and small hydro present huge investment opportunity in the sector in coming years, (c) Green Buildings: One billion sq. ft. of green buildings is being targeted to be set-up in India by the year 2012, leading to significant investment requirement in the sector, and (d) Cleaner Conventional Energy Technologies: Indian government has set a target of having up to 50 percent of new thermal power generation capacity based on clean coal technologies. The investment requirement in clean conventional energy technologies is relatively higher, at present.' Available at <http://www.cii.in/Sectors.aspx?enc=prvePUj2bdMtgTmvPwvisYH+5EnGjyGXO9hLECvTuNvtoshNFjXWF9pWApZBDgh>.

45. Statement by Jayanthi Natarajan, Minister of Environment and Forests, Government of India, High Level Segment, 17th Conference of Parties (CoP 17), Durban, 7 December 2011 available at http://unfccc.int/files/meetings/durban_nov_2011/statements/application/pdf/111207_cop17_hls_india.pdf.
46. For the story of how LANCO Infratech, a major conglomerate, subverted rules to acquire a stake in the solar mission much larger than allowed legally by setting up front companies that bid for solar power projects under Jawaharlal Nehru National Solar Mission getting nine projects (when one-project-per-proponent was the norm) under its arm cornering an assured revenue of about ₹13,000 crore, see Bhushan and Hamberg (2012).

References

- Bhushan, C. and J. Hamberg. 2012. 'The Truth about the Solar Mission,' *Down to Earth*, 15 February. Available at <http://www.downtoearth.org.in/content/truth-about-solar-mission>.
- Böhm, S. and S. Dabhi (eds.). 2009. *Upsetting the Offset: The Political Economy of Carbon Markets*. London: MayFly Books.
- Bond, P. 2011. 'Durban's Climate Zombie Tripped by Dying Carbon Markets,' 22 December. Available at <http://www.zcommunications.org/durban-s-climate-zombie-tripped-by-dying-carbon-markets-by-patrick-bond>.
- Chestney, N. and J. Coelho. 2011. 'Analysis: Carbon markets still on life support after climate deal,' *Reuters*, 12 December. Available at <http://www.reuters.com/article/2011/12/12/us-climate-carbon-idUSTRE7BBOQT20111212>.

- Coelho, R. 2009. 'Rent Seeking and Corporate Lobbying in Climate Negotiations,' in S. Böhm and S. Dabhi (eds.), *Upsetting the Offset: The Political Economy of Carbon Markets*. London: MayFly Books.
- Dubash, Navroz K. 2007. 'Inconvenient Truths Produce Hard Realities: Notes from Bali,' *Economic and Political Weekly*, 42(52): 31–35. Available at <http://epw.in/epw/uploads/articles/11376.pdf>.
- GoI. 2008. *Development Challenges in Extremist Affected Areas, Report of An Expert Group to Planning Commission*. New Delhi: Government of India. Available at http://planningcommission.gov.in/reports/publications/rep_dce.pdf.
- Gupta, J. 2009. 'India Unhappy with Bonn Climate Talks.' Available at http://unfccc.int/files/meetings/sb30/press/application/pdf/india_unhappy_with_talks.pdf.
- Gupta, S. 2002. 'Dithering on Climate Change,' *Economic and Political Weekly*, 37(51): 5073–76. Available at <http://epw.in/epw/uploads/articles/4860.pdf>.
- Harris, Paul G. 2003. *Global Warming and East Asia. The Domestic and International Politics of Climate Change*. London: Routledge.
- Lohmann, L. 2006. 'Carbon Trading. A Critical Conversation on Climate Change, Privatization and Power,' *Development Dialogue*, 48. Uppsala: Dag Hammarskjöld Foundation. Available at <http://www.thecornerhouse.org.uk/pdf/document/carbonDDlow.pdf>.
- . 2011. 'The Endless Algebra of Climate Markets,' *Capitalism Nature Socialism*, 22(4): 93–116. Available at <http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/LohmannCNSarticle.pdf>.
- . 2012. 'Financialisation, Commodification and Carbon: The Contradictions of Neoliberal Climate Policy,' *Socialist Register*, 48, 85–107. Available at <http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/Socialist%20Register%20Neoliberal%20Climate%20Policy%20Contradictions.pdf>.
- MoEF. 2010. *National Mission for A Green India under the National Action Plan On Climate Change*. New Delhi: Ministry of Environment and Forest, Government of India. Available at <http://moef.nic.in/downloads/public-information/GIM-Report-PMCCC.pdf>.
- Narain, S. 2011. 'Equity: The Next Frontier in Climate Talks,' *Down to Earth*, 31 December. Available at <http://www.downtoearth.org.in/content/equity-next-frontier-climate-talks>.
- Olivier, Jos G.J., Greet Janssens-Maenhout, Jeroen A.H.W. Peters and Julian Wilson. 2011. *Long Term Trend in Global CO2 Emissions: 2011 Report*. The Hague: PBL Netherlands Environmental Assessment Agency. Available at http://edgar.jrc.ec.europa.eu/news_docs/CO2%20Mondiaal_%20webdef_19sept.pdf.
- Padukone, N. 2010. 'Climate Change in India: Forgotten Threats. Forgotten Opportunities,' *Economic and Political Weekly*, 45(22). Available online at <http://epw.in/epw/uploads/articles/14808.pdf>.

- Planning Commission. 2008. *Social Sector, Eleventh Five Year Plan 2007–12*, 2. New Delhi: Planning Commission, Government of India. Available at http://planningcommission.gov.in/plans/planrel/fiveyr/11th/11_v2/11th_vol2.pdf.
- Times of India*. 2010. 'Greenhouse gases rise to record high in 2010: UN.' Available at <http://timesofindia.indiatimes.com/home/environment/developmental-issues/Greenhouse-gases-rise-to-record-high-in-2010-UN/articleshow/10818154.cms>.
- Varad, P. 2011. 'India at Cancun: The Emergence of a Confident Dealmaker,' *Economic and Political Weekly*, 22 January, 46(4): 14–15. Available at <http://www.epw.org.in/epw/uploads/articles/15630.pdf>.
- Watts, J. 2010. 'India discloses carbon emissions for first time in more than a decade,' *The Guardian*, 15 May. Available at <http://www.guardian.co.uk/environment/2010/may/25/india-carbon-emissions>.

3

India's Energy Sector

A Critical Re-Look

Shankar Gopalakrishnan and Soumya Dutta

The issues sought to be raised in this study—the intersection between climate change impacts, economic policies and livelihood insecurity—are most powerfully brought out by an analysis of the energy sector. The energy sector is the focus of both domestic and international debates on climate change, as it is central not only to emissions (being the single biggest contributor to emissions at the global level) (Lazarus and Chelsea 2011), but also to welfare and development. In the climate change talks, industrial nations have thus been pressurizing others to change their energy production systems; at the domestic level, struggles over energy—in particular, electricity production—are at the heart of interlinked crises of small industry, employment, displacement, environmental destruction and livelihoods.

Thus, looking at the energy sector allows us to see how the questions raised in this study overlap. At present, the Indian government's plans for meeting rising energy demand involve large-scale increases in extractive industries (coal mining in particular), dam construction and other forms of land takeover for intensive extraction and use of natural resources; they also involve plans for large numbers of new thermal, hydroelectric, natural gas, nuclear and renewable-driven power plants.

All of these initiatives have economic, social and health implications for the millions of people likely to be affected by them. In the context of the international talks, these programmes also raise questions about whether this is the best way for India to leverage its position on climate change, development and historical responsibility.

In particular, is this 'energy demand' in fact driven by the basic and welfare needs of the population, and are the current policies the best way to address it? Will they make sense in the context of climate change, or open India to greater physical impacts? Are they the correct use of the negotiating space available to the country, or do they constitute a failure to use the international talks process to India's advantage? These are some of the questions explored here.

3.1 Character of India's Energy Sector and Trends of Change

Estimates vary about the proportion of India's energy consumption that is from 'non-commercial' or 'traditional' sources of energy (one estimate is that 18 percent of energy is provided by 'biomass' for household use) (de la Rue du Can et al. 2009). However, while this still forms a major part of primary energy (energy that is produced), the share is rapidly declining. According to the government's Integrated Energy Policy, commercial energy is expected to form 83 percent of total energy supply by 2021 and to reach 90 percent by 2031. Moreover, use of non-commercial energy is mainly concentrated among households. The sectors that will experience the most rapid growth in energy use—industry, commercial activities and transport—all rely almost entirely on commercial energy (*ibid*). Household use is also increasingly shifting away from non-commercial and traditional sources to commercial ones (*ibid*).

Therefore, as one would expect, the projected growth in energy production in India will be met primarily through commercial energy sources. Out of these, the largest is, of course, electricity, and this is also projected to be the fastest growing form of energy production over the next 15 years (*ibid*). Other than electricity, both the government's Integrated Energy Policy and de la Rue du Can et al.

(2009) project that three other major sources of primary energy are also likely to increase: oil, natural gas and coal. Further, renewable energy sources (mainly hydroelectricity) and nuclear energy are also projected to increase.

Government policy therefore, aims at a sharp increase in energy production. This is mainly focused on electricity generation. Thus, according to one commentator, the Planning Commission and the Power Ministry believe that 'India needs to grow its primary energy supply at least 3 to 4 times and electricity supply 5 to 7 times, [as compared to] today's consumption, to deliver a sustained growth of 8 percent through 2031' (Ghosh and Yasmin 2008). While energy intensity has declined with growth (Rao et al. 2009), electricity use has increased (Ghosh et al. n.d.). During the Eleventh Plan the first target for capacity increase was 72,000 MW, which was then upgraded to 92,000 MW, before being reduced again.

Below, we look at each of the main sources of energy in turn, before returning to the question of the demand for energy and its driving factors.

Coal

Coal is currently India's largest source of energy, and it is projected to remain so, despite its extremely negative impacts. As per the Eleventh Five Year Plan, coal meets approximately 51 percent of India's total energy requirements, and the Central Electricity Authority estimated that, from 1 April 2011 to 1 March 2012, coal-fired thermal power plants provided 66.2 percent of India's electricity generation capacity.¹ Although India is the third largest coal producer in the world, the thermal power sector faces a chronic shortage of coal, which was estimated to rise to 105 million tonnes this year (TERI 2004). Coal is drawn upon both for power generation and for direct use, particularly by the steel industry.

Coal continues to receive heavy public and government support. Lazarus and Chandler (2011) estimate that Coal India Limited, the public sector coal mining corporation, subsidizes the cost of

coal by around 50 percent. The World Institute for a Sustainable Environment found that total subsidies to existing power plants, particularly thermal ones (for which certain special target-based subsidies are provided), added up to an estimated 150 percent of investment (WISE 2008).

At present, the coal sector is the subject of massive expansion plans through both public and private investment. The government approved 173 new coal-fired power plants in 2010 alone (Vidal 2011). While the share of coal in total electricity generation may decline, current plans still see coal as the single largest source of energy for the foreseeable future.

The Question of Efficiency

The government, and many other commentators, take the position that emissions from coal can be significantly reduced through technological measures—in particular, by shifting to supercritical boiler technology. Thus, in a joint presentation by the Governments of India and Japan, it is claimed that 1.4 GT of emissions can be saved if the Major Economies Forum (MEF) countries switch to 45 percent efficiency technology (i.e. supercritical boilers) in all cases where plants are more than 20 years old (GoI 2009). Ultra mega power projects in India are now required to use supercritical technology, and all new plants being constructed by NTPC use it (Lazarus and Chandler 2011). Rao et al. (2009) claim that ‘India’s future carbon intensity depends heavily on technology shifts in the coal sector towards supercritical coal plants.’

Yet there is considerable doubt about whether supercritical technology can achieve what is being expected of it. Lazarus and Chandler point out that ‘state of the art ultra-supercritical plants’ can achieve a *design* efficiency of 45 percent to 46 percent (Lazarus and Chandler 2011). However, they then note: ‘Coal unit efficiency is influenced by factors other than boiler technology such as cooling technology, the use of pollution abatement equipment, and the moisture, ash, and sulfur content of the fuel. Together, these variables can affect relative unit

efficiency by 7 percent or more. In other words, these variables can have *as great an impact on unit efficiency as the choice of boiler technology*' (emphasis added). They further point out that a U.S. Environment Protection Agency study found that supercritical plants only produced an efficiency increase of 3.1 percent (as compared to an expected gain of nearly twice of that). If this is the case in the United States, the results are unlikely to be better, and likely to be considerably worse, in India. Indeed, the government itself accepts that there are 'barriers to the development and deployment of HELE coal technologies and practices, includ[ing] insufficient information; varying qualities of coal; the high upfront cost of advanced HELE coal technologies; lack of appropriate price, financial, legal, and regulatory frameworks; inadequate operations and maintenance skills; and insufficient research, development, and demonstration' (GoI 2009).

As such, a high dependence on coal seems likely to lead to sharp increases in emissions. Coal is the most carbon-intensive of all fossil fuels; for every MWh of power generated, anthracite coal produces roughly double the carbon dioxide emissions of natural gas and about 50 percent more emissions than oil-based generation.² It is important to note that, aside from supercritical technology, the government appears to have few other plans for tackling this.

Impacts of Coal Use: Coal Mining

Aside from carbon emissions, perhaps the largest single impact of coal use occurs in the areas where it is mined. More details of this are provided in the annexed theme paper on coal and thermal power; this is only a brief summary.

Eighty-eight percent of coal production in India is from open cast (or strip) mines and all new mines are of this type (Singh 2011). Singh quotes the 9th Plan Working Group as estimating that 2000 acres (810 hectares) are required for every million tonnes of coal to be mined (*ibid*). Though existing mines are smaller than this average would imply, if we accept this target, the government's projected addition of 1267 million tonnes of coal mining capacity by 2024–25

will require 593,730 additional hectares of land (as compared to the present 147,000 hectares). It should be noted that coal mining has destroyed approximately 2.4 million hectares of land in the U.S., much of which cannot be regenerated; replanting projects in the State of Montana had a success rate of only 20–30 percent while some of those in Colorado had a success rate of below 10 percent (Greenpeace 2010). No similar figures appear to have been compiled for India. There are, however, at least ‘240 abandoned mines where no reclamation has taken place’ (CSE 2011).

Independent estimates state that approximately five million people have been displaced or affected by mining, the vast majority by coal (Singh 2011). More than 75 percent are estimated to be worse off than before. Given that the area of land required for such mines is likely to rise by more than four times, a huge population of people are likely to be directly affected by coal mining if these targets are sought to be met. Given the track record of the government in terms of implementation of rehabilitation and resettlement policies, the fate of those affected can be imagined; in one of the few documented studies of rehabilitation, it was found that all those displaced by the mines had experienced a net loss of income and were in severe poverty (CSE 2011). Aside from the inherent inhumanity of such a policy, such a huge displacement will add immensely to the problems that society will already be experiencing as a result of climate change and economic reforms.

Moreover, even the very high mining targets set by the Power Ministry are in turn outstripped by the takeover of land for coal mining. Thus, the Centre for Science and Environment (CSE) found that between 2006 and 2011 alone, the Environment Ministry had granted environmental clearances for 583 million tonnes of additional coal mining, which is more than the present total capacity of mines in the country (537 MTPA) and would mean that 1120 MTPA capacity could be achieved by these mines alone—almost the target for 2024 (*ibid*). Needless to say, however, clearances are continuing. Meanwhile, between 2007 and 2011, 26,000 additional hectares of forest land were diverted for coal mining (*ibid*), at a time when Coal India Ltd.

is already producing considerably less than its capacity and lacks the infrastructure to even remove the coal that it has mined. More than 50 million tonnes of coal was lying at rail pitheads in May 2011 (Mehdudia 2011).

Further, coal mining affects far more people than those within the mining area alone. Toxins such as arsenic, fluorine, mercury, and so on enter water supplies from mines and also enter the atmosphere from coal fires during mining. As a result, according to a 2001 study in the U.S., 'cardiopulmonary disease, chronic obstructive pulmonary disease, hypertension, lung disease, and kidney disease have been found in higher-than-normal rates among residents who live near coal mines' (Greenpeace 2010). The transportation of large amounts of coal over long distances spreads coal dust across huge areas. Coal mine workers suffer from extremely high rates of lung disease (*ibid*).

Indeed, coal mines wreak destruction on the entire landscape. Thus, the Damodar river in West Bengal, whose basin produces some 60 percent of India's medium grade coal, is now classified as one of the most polluted rivers in the country. The valley's forest cover has dropped from an estimated 60 percent to 0.05 percent (CSE 2008). More than one third of operational coal mines in the valley are violating environmental norms, and a large share of newly cleared coal mines are in areas already classified as critically polluted (CSE 2011).

Impacts of Coal Use: Coal-Fired Power Plants

In 2010 alone, India approved plans for 173 new thermal coal-fired power plants, with an estimated capacity of producing 80–100 GW of electricity (Vidal 2011). This production is also heavily concentrated in certain regions.

Thermal power plants driven by coal are exceptionally destructive. Singh estimates that, if thermal power production retains its current share, new thermal power plants will require an additional 14,744 hectares of land between 2017 and 2022 if the target for thermal power production is to be achieved (Singh 2011). This will cause additional displacement and impoverishment in these areas. Moreover,

once again, the number of projects cleared outstrips the planned target. Thermal power projects of 210,000 MW capacity have been given environmental clearance over the course of the Eleventh Five Year Plan. This is 1.5 times more than the entire existing capacity of 118,000 MW, and greater than the Eleventh and Twelfth Plan targets. These add up to only 150,000 MW (CSE 2011). Out of the projects cleared, 176,000 MW is to come from coal-fired plants.

Coal fired power plants are also extremely polluting. As per Lazarus and Chandler (2011), 'coal combustion now accounts for 70 percent of particulate emissions, 90 percent of sulfur oxide, and two thirds of nitrous oxide and CO₂ emissions... Coal ash, the residue of combustion, is now the number one source of solid waste in China.' Indeed, with India consuming around 630 million tonnes of coal in 2010, and with an average ash content of around 32 percent, the bottom and fly ash generated by coal burning amounts to around 200 million tonnes of coal-ash. To put this in perspective, this is only slightly less than India's total annual production of foodgrains, and would fill up 20 million truck-loads. A large part of this ash will never be reused, and instead will be dumped, exposed to the elements. All of this ash is laden with multiple hazardous chemical pollutants, including radioactive contaminants to some degree.

The World Bank has estimated that coal related respiratory diseases result in losses of \$100 billion; coal ash has been carried across the entire nation of China by dust storms, with ash from Inner Mongolia reaching the coastal cities (BIC and Sierra Club 2011). Coal power plants also produce large amounts of sulphur dioxide and nitrogen oxides, which are major pollutants with severe human health consequences (Greenpeace 2010). The water requirements of the power projects granted environment clearance in the Eleventh Five Year Plan period are estimated to be about seven billion cubic metres per year—equivalent to the requirements of one fifth of the country's population (*ibid*). A study of thermal power plants in India found that these plants affect water sources, while fly ash and coal dust emissions cause a

range of diseases, including respiratory tract trauma and skin ailments (NFFPFW et al. 2011).

Hydroelectricity

In the Indian context the alternative to thermal power that is constantly touted is hydroelectricity. According to the government, in 2007, hydroelectricity accounted for 26 percent of India's power generation capacity (GoI 2008). However, estimates of the share of actual production from hydroelectricity appear to differ. Thus the website of CARMA reports a figure of 16 percent for January 2010;³ de la Rue du Can et al. (2009) report 14 percent. This is consistent with the fact that hydroelectricity projects rarely achieve their projected targets (see below), as well as with the very large transmission and distribution losses that occur in India—and which are likely to be higher in the case of remote projects such as most dams.

The government has generally promoted the potential of hydroelectricity as a major source of power for India's future. The Planning Commission and the Power Ministry have stated that hydroelectricity should be the main form of production for achieving India's targets (Ghosh and Yasmin 2008); the 2008 National Hydro Power Policy reiterates the old goal of returning to a 60:40 thermal to hydro share in power generation in India (the ratio is claimed to have been 56 percent to 44 percent in 1970) (GoI 2008). The National Hydro Power Policy estimates that India's hydroelectric power generation potential is '84,000 MW at 60 percent load factor (148,700 MW installed capacity),' but only 15 percent of this is used, while 7 percent is under development, leaving 78 percent for 'potential exploitation'.⁴ One should note however that independent estimates do not always concur with the projection of hydroelectricity greatly increasing its share of actual production (whatever its contribution to capacity) in the future; CARMA once again projects a decline from 16 percent to 15.33 percent, while the ALGAS estimates from 1999, projected a share of 23.1 percent in 2020 (ADB et al. 1998).

Indeed, hydroelectricity often does not live up to the claims made for it. Thus, in 2009, 89 percent of hydroelectricity stations were performing below their sanctioned capacities, and half of these were not even generating 50 percent of their sanctioned capacity (Thakkar 2009). The reasons include siltation, improper maintenance and variation in water flow. Indeed, even government officials acknowledge that the detailed project reports prepared for these projects rarely have appropriate information, and specifically note that siltation and ‘geological surprises’ have hampered many projects (*Power Line* 2009a).

Impacts of Hydroelectricity Production

Hydroelectricity is often advertised as a climate friendly form of power generation. However, in 2007, a study by Brazil’s National Institute of Space Research estimated that 33.5 MT of methane is being emitted by India’s large dams every year (Thakkar 2007). However, it should also be noted that methane’s life in the atmosphere is very short, as compared to that of carbon dioxide, and therefore the impact of such emissions is not directly comparable and requires further study.

The displacement and devastation caused by large dams, whether for hydroelectricity or otherwise, is too well known to need repeating here. Beyond this, however, other impacts also occur. These include artificial or exaggerated floods triggered by mismanagement, such as that of the Mahanadi river in 2008 (Thakkar 2009) and the Tungabhadra-Krishna floods of 2009, where the Srisailem reservoir was kept full long after the monsoon ended in order to maximize power generation. The environmental impact on river ecosystems is enormous, as is the impact of large bodies of water. Thus Abbasi and Abbasi (2011) note that ‘Natural lakes take hundreds of years to evolve from oligotrophic (low in nutrients) to eutrophic (rich in nutrients) status. But man-made reservoirs underwent this transition within a few years, degrading water quality, harming fisheries, bringing siltation and invasion by weeds, and

creating environments suitable for mosquitoes and other disease vectors' (Abbasi and Abbasi 2011).

The utter apathy of the State administration towards resettlement and rehabilitation is also well known. As stated by a Joint Secretary of the Ministry of Power, 'In the course of constructing a hydro project, certain conditions with respect to the environment must be met. Surprisingly, these obligations have not been adhered to in the recent past, especially in the case of dumping sites. However, in the long run, the sector will have to pay heavily for this environmental damage... The increasing silt content in river basins has made many projects come to a standstill. The forest department is lagging behind in completing catchment area treatment plans for numerous projects' (*Power Line* 2009b).

In recent years, in order to avoid the problems of large dams, there has been increased promotion of 'run of the river' projects and 'micro hydroelectricity projects' (less than 25 MW in size). The latter are discussed under 'renewables' below. 'Run of the river' projects have also suffered from severe problems. Many such projects are built on the basis of unrealistic and inaccurate flow calculations. The biggest such project—Nathpa-Jhakri on the Sutlej in Himachal Pradesh—had to be shut down several times over the last few years due to damage to turbines and other machinery from heavy silt-flow. The channel of the river has been narrowed down by dumping of excavated materials, leading to further flow disruptions (*Himachal Live* 2010).

Further, as observed by P. Abraham (2009), the then chairman of the Expert Appraisal Committee in the Ministry of Environment and Forests, 'what has happened is that... rivers flow through tunnels for long stretches and there is no river left at all, since all its water flows through the tunnels. Sometimes each tunnel is about 20 km long. Further, one head-race tunnel is followed by a tail-race tunnel, then again a head-race tunnel, and so on. Over a span of 60–70 km, there are only tunnels and no river. This is a major concern.' With three such projects already functioning and 30 more planned, it has been said that the river Sutlej will 'disappear' (Asher

2011). This has resulted in protests and resistance from those who have been deprived of water and livelihoods by such large-scale run of the river projects. Entire river valleys are being destroyed by such projects, resulting in the displacement of communities and ecological destruction in States such as Himachal Pradesh and Uttarakhand. Many such projects are given to private companies, which in turn results in further exclusion of local communities as a result of the privatization of the river, surrounding lands and forests, and nearby infrastructure. Many of these projects also, ironically, have CDM status (NFFPFW et al. 2011).

Impact in the Northeast

Moreover, as in the case of thermal power plants, the impact of hydroelectricity will not be uniformly distributed. Thus, in the 2008 National Hydro Power Policy, the Brahmaputra basin alone is estimated to have a capacity of 66,065 MW—twice that of the second largest, the Indus basin, and 44 percent of the country's total (GoI 2008). The Ministry of Power also states that 'almost half the targeted capacity will come from the north-eastern States' (*Power Line* 2009b). An estimated 168 dams are planned for the State of Arunachal Pradesh alone (Mitra 2011). Thus, if the government's hydroelectricity plans are to come through, a large part of the impact will fall on the hilly areas of the northeast.

These are areas inhabited by indigenous (tribal) communities who practice communal land ownership and democratically control their land and forests. These systems of collective production have ensured that extreme poverty and landlessness are practically nonexistent in these areas, ensuring a standard of human development that is among the highest in the country.

The devastation that would be caused to such societies by the construction of hundreds of dams can only be imagined. The entire way of life of millions of people would be destroyed. Moreover, for most of these areas, such as Arunachal Pradesh, the hill areas of Manipur, the States of Nagaland and Mizoram, and most of Meghalaya,

there are no cadastral surveys and no land records (since the land is owned by the community). Thus even the abysmal rehabilitation packages that are provided in central India—which are based entirely on recorded rights—would not be provided in these areas, ensuring that the deprivation inflicted would be total.

Finally, the downstream impacts of such a huge number of dams would affect large numbers in both Assam and Bangladesh, impacting agriculture and livelihoods across the range of these rivers. Given these realities, it is not surprising that protests and resistance to these plans are already increasing. At the time of writing there are intense protests underway, joined by tens of thousands of people, against the Lower Subansiri Dam project on the Assam-Arunachal border. Manipur's Tipaimukh dam has seen similar protests (including across the border in Bangladesh). The much sought after and projected expansion of hydroelectricity in India is thus likely to engender massive conflict and bloodshed.

Nuclear Power

In India, an indigenous nuclear establishment was started by the government not long after independence. This was done in August 1948. However, the use of commercial quantities of nuclear fission generated power started about 42 years ago, in 1969, with the commissioning of the U.S. supplied 160 MW boiling water type Tarapur-I reactor.

Today, the Atomic Energy Commission, the department under it and its various aided research and development agencies handle a wide variety of tasks, including nuclear weapons development, radio-isotope production, power, research on reactor designs and so on. For the specific purpose of setting up and operating power reactors, the Nuclear Power Corporation of India (NPCIL) was set up much later in 1987. In the 42 years since Tarapur-I, the total installed capacity of all the 20 operating reactors (located in six States of India) had reached about 4800 MW by the end of 2011, or just about 2.6 percent of the total installed electricity generation capacity in the country. The actual power generation over the last few years is even less than this small

percentage, largely because of uranium shortage. Thus, it needs to be noted that the contribution of nuclear power in India is very small, even after over four decades of commercial operation and despite massive government subsidies to the sector. Another 6000+ MW of power reactors, of various types and from different suppliers, are in various stages of construction. The government, though, has a massive plan to scale up this capacity to over 60,000 MW by 2032 (PTI 2010)—out of a projected total installed capacity of around 780,000 MW in that same year (IEP). This plan has been made, notwithstanding the continuing massive protests of people in all the new sites, the global re-think about nuclear energy in the wake of the Fukushima nuclear disasters in Japan, the many dangers and unsolved problems of disposing radioactive wastes and the global uranium shortage. It is another matter though that the actual installed capacity of the Indian nuclear establishment has consistently fallen far short of its projections.

Nuclear power reactors in India use primarily natural or un-enriched uranium as fuel, with ‘heavy-water’ used as both moderator and coolant in what are known as Pressurized Heavy Water Reactors (excepting a couple of U.S. supplied reactors that use lightly enriched uranium and light water, and also experimental reactors using mixed plutonium-uranium oxides as fuel). In view of the ongoing uranium shortage, the Atomic Minerals Directorate and the government owned Uranium Corporation of India have undertaken country-wide explorations, and have located reserves in different places in Andhra Pradesh, Meghalaya, and so on—in addition to the existing mines in Jharkhand State. These newfound reserves are ostensibly big enough to meet India’s present uranium needs of around 500 tonnes per year, and are even claimed to be large enough to meet the projected vast increase in demand over the next few decades. Here too, the local populations—in proposed new mining sites such as Domisiat in Meghalaya, Tummalapalle in Andhra Pradesh, and Gogi in Karnataka—are up in arms against these proposals. The Meghalaya site has seen no progress over the last eight years due to strong people’s resistance. The real picture of the state of the Indian nuclear power establishment, however, is difficult to get, as most information

is kept secret even from other government agencies and from parliamentarians, under the stringent secrecy provisions of the Atomic Energy Act.

As a source of power (electricity), nuclear energy has many serious problems that have not been resolved, not the least of which is the radioactive waste disposal issue. Any nuclear (fission) reactor will generate significant amounts of radioactive wastes while in operation. These are categorized as high-level (requiring total isolation), mid-level and low-level radioactive waste. On an average, a 1000 MW reactor will generate around 30 tonnes of high-level waste in a year's operation (along with a far larger amount of medium and low level wastes), and these are extremely dangerous and long-lived. According to U.S. Nuclear Regulatory Commission (admittedly a nuclear energy friendly organization):

.... uranium atoms during reactor operation creates radioactive isotopes of several lighter elements, such as cesium-137 and strontium-90, called 'fission products,' that account for most of the heat and penetrating radiation in high-level waste. Some uranium atoms also capture neutrons from fissioning uranium atoms nearby to form heavier elements like plutonium. These heavier-than-uranium, or 'transuranic,' elements do not produce nearly the amount of heat or penetrating radiation that fission products do, but they take much longer to decay. Transuranic wastes, also called 'TRU,' therefore, account for most of the radioactive hazard remaining in high-level waste after a thousand years..

Radioactive isotopes will eventually decay, or disintegrate, to harmless materials. However, while they are decaying, they emit radiation. Some isotopes decay in hours or even minutes, but others decay very slowly. Strontium-90 and cesium-137 have half-lives of about 30 years (that means that half the radioactivity of a given quantity of strontium-90, for example, will decay in 30 years). Plutonium-239 has a half-life of 24,000 years. (NRC 2007)

It is to be noted that radioactive material is considered safe only after 10 half-lives. Thus plutonium-239 will remain very hazardous for living beings and the ecology for nearly a quarter of a million years, while the entire history of human civilization so far has consisted of a mere 5000 to 6000 years.

The Nuclear Regulatory Commission continues:

High-level wastes are hazardous to humans and other life forms because of their high radiation levels that are capable of producing fatal doses during short periods of direct exposure. For example, ten years after removal from a reactor, the surface dose rate for a typical spent fuel assembly exceeds 10,000 rem/hour, whereas a fatal whole-body dose for humans is about 500 rem (if received all at one time). Furthermore, if constituents of these high-level wastes were to get into ground water or rivers, they could enter into food chains. Although the dose produced through this indirect exposure is much smaller than a direct exposure dose, there is a greater potential for a larger population to be exposed.

The Indian nuclear establishment claims that they are undertaking a three-stage nuclear power programme, in which uranium reactors are only the first stage. The highly radioactive and toxic plutonium will be extracted from spent fuel and used as fissile material in Fast Breeder Reactors in the second stage, thus eliminating the problem of storing or disposing of it. These second stage reactors will expose abundantly available indigenous thorium-232 (found in good proportions in the monazite sands in Kerala and Tamil Nadu) to radiation and thereby convert it to fissile uranium-233, which will then power the third stage nuclear reactors for many decades or even perhaps for a few centuries. The only drawback in this scheme is the fact that no other country has been able to follow this extremely difficult technological path, and the U.S., Japan and France all had to abandon their breeder reactor programmes after repeated serious accidents. India too has not been able to operationalize its Prototype Fast Breeder Reactor (PFBR) for the last 15 years. Further, even a safe geological storage for high level radioactive waste cannot be made secure and foolproof; even the U.S. has recently abandoned its decades old and hugely expensive Yucca Mountain storage project. Many industrial countries are currently storing their radioactive waste in temporary storage (or have been dumping these in the oceans inside sealed stainless steel containers), without any clear answer to what will happen to this

dangerous radioactive materials in case of natural or man-made disasters. These are likely to be also targets for theft, particularly in countries like India with lax enforcement.

There are many processes that generate and release radioactive materials in the entire nuclear fuel cycle—including the mining of uranium ores, to milling, refining, yellow-cake production, fuel fabrication, transportation of these materials, radioactive wastes and so on. At every stage, these materials pose grave threats not only to the nuclear plant workers, but also to numerous people around the mines, fabrication factories, reactor sites, etc. There are documented studies that these populations suffer a much higher incidence of a host of deadly diseases, including various forms of cancer. The high radiation risk to populations is not only from spent fuels or other radioactive waste. Throughout its 'normal' operation, a reactor has to emit radioactive gases (along with fine radioactive particulates) as these will otherwise build up inside the reactor. Iodine 131, caesium 134, caesium 137 and many other radioactive elements are regularly vented into the atmosphere, leading to a number of serious health effects in the surrounding populations. In India, Surendra Gadekar and others have documented many such cases around the Rawatbhata nuclear power plant near Kota in Rajasthan (Ramana and Reddy 2003).

The very real possibilities of catastrophic nuclear accidents have been brought back into the limelight after the Fukushima disaster of March 2011, whose full impacts will unfold over the coming decades. Prior to this, the 1986 Chernobyl disaster, in what is now the Ukraine, has been thoroughly studied, and its deadly impacts have been well documented. According to the United Nations Office for the Coordination of Human Affairs,

Nearly 8.4 million people in Belarus, Ukraine and Russia were exposed to radiation. Some 150,000 square kilometres, an area half the size of Italy, were contaminated. Agricultural areas covering nearly 52,000 sq km, which is more than the size of Denmark, were ruined. Nearly 400,000 people were resettled but millions continue to live in an environment where continued residual exposure created a range of adverse effects. Now, roughly 6 million people live in affected areas. Economies in the region have stagnated, with the three countries directly affected

spending billions of dollars to cope with the lingering effects of the Chernobyl disaster. Chronic health problems, especially among children, are rampant. (UN-OCHA 2004)

According to a study released in December 2009 by the New York Academy of Sciences, in the Chernobyl nuclear accident 985,000 deaths have taken place all over the northern hemisphere over the following 22 years (Yablokov et al. 2009).

According to CEA data, nuclear fission-based power generation provided only 3.6 percent of India's electricity production between April 2011 and March 2012.⁵ But it has enormous risks for large segments of our population and several unresolved critical issues. It will be prudent for our energy and safety planners to abandon this dangerous route to electricity.

Natural Gas

Available data indicates that the most likely substitute for coal is not hydroelectricity but natural gas. For instance, the 1999 estimates of the ADB et al. (1998) show natural gas climbing to a share of 31 percent of total generation capacity by 2020. In 2006, TERI also estimated that natural gas would achieve a share of 20 percent of total capacity by 2025 (TERI 2004). The Integrated Energy Policy of the government has a more conservative estimate of a 16 percent share (Rao et al. 2009). In 2009, natural gas reached nearly a 10 percent share of power generation (*ibid*).

The sharp rise in natural gas use, however, is not a given, despite recent policy changes to encourage private sector participation. Jackson (2007) notes that an increase in the share of natural gas depends heavily on a reduction in subsidies to coal-fired plants and that prices charged by private suppliers have often been very high. The recent widely reported controversy over underproduction in the Krishna basin fields, allocated to Reliance, is a good example of the problems that can ensue from private development of gas fields. Reports indicate that the Comptroller and Auditor General is likely

to indict this project for resulting in massive losses to the exchequer. Rao et al. (2009) note that, 'while the government envisages a tenfold increase in gas supply, significant uncertainty surrounds the likelihood of this achievement as a result of technical, financial and institutional barriers.'

In emissions terms, it has often been argued that natural gas is better than coal. Thus, one commentator argues that 'for every kilowatt-hour of electricity produced, methane emits 0.35 kilograms of carbon dioxide, compared to an average of 0.80 kilograms for coal and 1.2 kilograms for lignite, a form of coal with lower calorific value' (*Climate Lab* n.d.).

However, natural gas drilling is not free of impacts. The high likelihood of spills and leakages can lead to various kinds of disasters, particularly as gas drilling is usually combined with drilling for oil. Most production in India comes from offshore fields, where a spill can cause damage and destruction across a huge area (as evinced by the recent British Petroleum spill in the Gulf of Mexico). A massive expansion in natural gas drilling only makes such damage more likely. India has little experience in handling such disasters and it is unlikely that plans and systems are in place for dealing with one. Drilling for unconventional shell gas reserves, which are projected to be larger in India than conventional ones, also usually takes place through hydraulic fracturing or 'fracking'—an extremely polluting process. Finally, the large-scale laying of pipelines will also require huge areas of land and increase the risk of disasters.

Renewables (Other than Large Hydroelectric Projects)

Since the late 1990s, the Indian government has been taking steps to promote renewable energy sources, and a separate Ministry was established for the purpose. Rao et al. (2009) note that India's share of renewable energy use is among the highest of major nations and that it has 'consistently overachieved' on targets for renewable energy sources. Between 2000 and 2009 capacity addition through renewable energy (excluding large hydroelectricity) amounted to nearly a quarter of total

capacity addition in electricity generation, and most States have fixed percentage targets for purchase from renewable energy sources (*ibid*).

But these policies have proven insufficient to greatly increase the share of renewable sources in India's electricity production. Thus, the CARMA database estimates that, as of January 2010, renewables (other than hydroelectricity) produced approximately 1.6 percent of India's total power generation; and the database predicts a drop to 0.75 percent over the next decade.

While electricity generation from renewable sources does not have the massive, devastating impacts that thermal and hydroelectric forms of generation do, this does not mean that it has no impacts at all. There are a number of interlinked problems with such production. First, there are issues of material availability which might affect the switch-over to renewable sources. The rare-earth metals required for wind turbine generators and some other renewable applications are already in short supply. Second, most renewable sources are inherently intermittent in nature, necessitating the use of storage technology that is extremely expensive. Lithium for advanced storage batteries is also facing shortages. Third, as a result of these factors, the actual generation of renewable power can be considerably below the total capacity of the generating station, leading to inflated expectations.

Finally, as discussed below, the current practice of linking major renewable energy production to the national grid effectively defeats many of the advantages of renewable energy and exacerbates its costs, inefficiencies and negative impacts. Thus, what is required is not merely a wholesale switch-over. As discussed below, the manner in which these sources are being used and planned today has already resulted in negative impacts and growing problems, which are only likely to be exacerbated in the years to come. Therefore, the crucial question is not only one of energy production, but of planning and decision-making.

Wind Energy

Wind energy has been the most rapidly expanding form of renewable electricity generation in India, and wind projects accounted for more

than two-thirds of the capacity addition in renewables between 2000 and 2008 (Rao et al. 2009). Wind projects have been the recipient of large amounts of subsidies.⁶

Notwithstanding the lack of emissions from wind energy projects, they have a number of other impacts. Wind energy projects require extensive areas of land. For instance, the Bureau of Land Management in the U.S. estimates that an area of three acres on average is required for each wind turbine; other estimates place the required area between three and seven acres (CEIWEF 2007). Thus a potentially huge area of land is required for every wind generation project; the website *altenergy.in* estimates that a 225 MW project may require an area of 35 km x 5 km in size. Such areas in turn are often cleared of forest or other large vegetation on them, both for the sake of the turbines themselves and for supporting roads and other infrastructure (*ibid*). The resulting damage to forests and ecosystems can vastly outweigh the benefits of the project, both in carbon emission terms and otherwise.

Moreover, the resulting land takeovers for wind projects have primarily targeted common and forest lands; as with any large project, since such lands can be more easily taken. This has already led to conflict. One major example is the Suzlon project in Dhule District, Maharashtra, where major protests and struggles have been underway. In 2007, a major clash took place between Suzlon and protesting adivasis who were demanding their rights over forest land under their cultivation. The State government had handed over 339 hectares of this land to the company, which was felling more than 30,000 trees as well (Teltumbde 2007). In Maharashtra and Karnataka, other wind energy projects installed by Suzlon and now owned by various large Indian corporations, in collusion with the local administration, have been found to be involved in a range of fraudulent practices and other unethical and illegal conduct in acquiring community-held lands and private lands belonging to the villagers; incidents of intimidation by the wind power companies as well as the police are also not uncommon (NFFPFW et al. 2011).

Similarly, in the Kalpavalli region of Anantapur District of Andhra Pradesh, common land that eight villages had restored to forest over the previous two decades has been handed over to Enercon, a wind energy company, for a 20 MW wind energy project. The company has proceeded to fell large numbers of trees, leading to fears of soil erosion and a reversal of the eco-restoration effort (Suchitra 2011).

More minor, but still significant, impacts from wind energy projects includes persistent noise and damage to wildlife, particularly bats and birds (CEIWEP 2007).

Biomass Energy

Energy from biomass, i.e. primarily from agricultural wastes and biofuel crops, has been a subject of considerable discussion in India. One estimate is that such generation can potentially reach 19,500 MW (TERI 2004); in addition, Kandhari and Pallavi (2010) quote an estimate of 16,000 MW from existing wastes and another 45,000 MW from growing biofuels. A number of States have put in place policies to promote such production, and the Eleventh Five Year Plan set a target of 500 MW of biomass power to be generated. It appears likely that this target has been met.

However, biomass energy has a major negative impact on surrounding communities. This takes multiple forms. As with all forms of power generation, pollution and fly ash are a major problem for those cultivating near such plants (NFFPPFW et al. 2011). In a study, NFFPPFW et al. (2011) found that, despite filing for CDM credits and committing to work with local communities, every biomass plant they visited had been set up without any meaningful community consultation. Moreover, none of the plants had fulfilled even a single one of the promises it had made regarding local infrastructure.

Further, biomass plants using agricultural wastes compete for fuel with the majority of the rural population, who rely on these wastes for many of their basic requirements and livelihood activities. Thus, an MNRE study found that ‘around 50 percent of

electricity generated in biomass power projects was derived from rice husk, 30 percent from wood (mainly *Prosopis juliflora*) and the remaining 20 percent was from agricultural residues' (Kandhari and Aparna 2010). Rice husk and agricultural residues are key forms of food for cattle, especially for those who cannot afford commercial fodder. In Andhra Pradesh and Rajasthan, use of mustard husk for biomass power generation has driven up costs to levels where they are unaffordable for local landless workers (*ibid*). Where agricultural waste is not used, biofuels have to be grown, requiring additional land. It is now well known that displacement of food crops by biofuel crops is a major cause of food insecurity, one that has triggered international concern.

Biomass electricity production also may defeat its own goals in terms of emissions. Biomass has an important role in maintaining soil fertility, and the soil organic carbon content in intensively farmed land has gone down over the last five decades. Lower soil organic carbon content leads to increased demands for both fertilizers and irrigation—both of which are energy and carbon-intensive. This also makes peasant farming more unviable by driving up input costs.

Finally, biomass projects have also been found to use uncertain amounts of coal as a 'fuel supplement' in periods of low 'raw material' availability. Project developers who apply for CDM status admit this on record in their statutory Project Design Documents submitted to the UNFCCC. Observations by communities affected by chronic pollution by biomass projects show that use of coal is rampant and unrestricted; in fact, some projects burn coal and biomass in equal proportions throughout the year (NFFPPFW et al. 2011).

Small Hydroelectricity Projects

Hydroelectricity projects of less than 25 MW capacity are classified as 'small' projects and come under the Ministry of New and Renewable Energy (GoI 2008). The National Hydro Power Policy assesses such projects to have a total capacity of around 6.7 GW in the country (*ibid*), and 13 States have announced policies for such projects

(Ghosh et al. n.d.). Internationally as well it appears to be the norm to treat such projects on a different footing than large hydroelectricity projects, since the impacts are far smaller and different in character.

The relative lack of experience with such projects makes it difficult to assess their impacts. However, as Abbasi and Abbasi (2011) note, such projects may carry many of the risks that their larger brethren do. Frequent interruptions of river flow and installations of turbines can adversely affect rivers and biodiversity. If such projects depend on small dams for storage, the cumulative effect of a large number of small dams can be as destructive of river ecology as a single large dam. Moreover, from the climate change point of view, at a theoretical level small reservoirs can be expected to proportionately generate more methane than large ones, since methane generation occurs at the water-sediment boundary.

All of these points mean that small hydroelectricity projects require careful study before they are promoted. In particular, the manner of generation is more important than the scale of the project. The mere fact that a project is below 25 MW in size does not mean that its impacts can be assumed to be benign.

Solar Energy

Solar energy has also received considerable policy and financial support. A separate Jawaharlal Nehru National Solar Mission was launched in 2009; earlier schemes for lanterns and photovoltaics were halted with the launch of the Mission (Harish and Raghavan 2011). The Mission, which is also part of India's National Action Plan for Climate Change (NAPCC), aims to establish 20 GW of solar production capacity in India by 2022 (Deshmukh et al. 2010). Capital subsidies and interest subsidies for purchase loans to consumers are also being promised.

Unlike in the case of wind, large-scale solar projects have so far been rare in India, and the impacts of such projects have not been felt. The high cost of solar power continues to be a major deterrent to such large-scale deployment; notwithstanding the subsidies. Indeed, through

an analysis of the various components of the National Mission, Deshmukh et al. (2010) find that the majority of the envisaged subsidy (approximately 60 percent) will not be borne by the state but will be generated by higher tariffs to consumers (₹21,000 crore out of an estimated ₹36,000 crore in present terms, assuming a discount rate of 10 percent). Moreover, only 7 percent of the subsidy in the Mission is actually targeted at the rural poor, who lack access to electricity.

Both Harish and Raghavan (2011) and Deshmukh et al. (2010) agree that the major problem with the National Solar Mission is the failure to clearly target and utilize solar technology in the manner for which it is best suited, namely decentralized, local and adaptable energy generation, particularly for the huge population of people who are off the grid. Instead, once again, the National Mission implicitly (through mistaken subsidies) and explicitly (through targets) prioritises large-scale solar production at a time when the costs of such production are still very high. Moreover, as in the case of wind power, large-scale solar power production—in particular through the use of solar thermal technology, which is cheaper than photovoltaics—requires land at appropriate locations. Even for photovoltaics, a back of the envelope calculation by *Solar Review* estimated that solar power through photovoltaics requires 30 sq km per GW (Zweibel 2010). While considerably smaller than some other sources of power generation (wind and large hydroelectricity, for instance), the amount of land involved is still significant—if, that is, the generation is sought to be done through large projects.

The Government's Trading Initiative

Section 86 of the Electricity Act of 2003 empowers State Electricity Regulatory Commissions to impose a 'renewable purchase obligation' in each State. From 2011, the government has initiated a process of trading in 'renewable energy certificates,' which are to be issued to producers of renewable energy. These can then be purchased by other electricity purchasers who are seeking to meet their renewable purchase obligations; purchase of a certificate is deemed to be the same

as purchasing an equivalent amount of actual electricity. Such trading was initiated for the first time in 2011.

Such a trading mechanism, however, suffers from all the flaws normally associated with such systems. These problems are discussed in more detail in chapter 4 on mitigation measures.

3.2 The Question of Energy Demand

The above discussion leads one to a number of conclusions. First, in the case of large-scale commercial energy production—especially electricity generation—the available alternatives all carry major social and ecological impacts. Further, in all three main cases—coal, hydroelectricity and natural gas—the technical measures being promoted for reducing emissions and mitigating climate change are scientifically questionable. Use of such measures may produce no net decrease in greenhouse gas emissions and in some cases (hydroelectricity in particular) may make the situation worse. Renewable energy sources, while they do not have such devastating impacts, carry potentially significant costs of their own, and moreover cannot realistically provide a major share of generation in the foreseeable future.

What then is to be done? It is clear that a large proportion of India's population still does not have access to adequate energy supplies. The electricity situation in particular remains dismal. Even as late as 2007, at least 42 percent of India's rural population was still using kerosene as its main form of lighting (Deshmukh et al. 2010); as of August 2010, 15 percent of villages were unelectrified, and the Ministry of Power estimates that 28 million households will remain without access to electricity even after the completion of the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGVY) in 2012 (Harish and Raghavan 2011). Clearly energy is a problem for large numbers of Indians.

Yet the answer to this question cannot and should not be the one that is most commonly supplied: that, therefore, generation of all kinds simply needs to be increased. History has shown that an increase in generation capacity does not necessarily translate into improved

access to energy for the majority of the population. Aside from the large number of people without electricity at all, a further 32 percent of the population consumes less than 50 KWH a year. Moreover, between 1996 and 2010, generating capacity in India grew by almost one lakh MW—but the number of households without electricity fell by only 10 percent (Krishnaswamy 2010). There is more to the story, clearly, than a mere overall shortage of generating capacity.

Therefore, given the enormous and, as in the northeast, potentially catastrophic impacts of the government's plans to accelerate energy production, a close examination of what is actually happening to our energy supplies is required. While a comprehensive examination of this is out of the scope of this paper, a few indicators can be noted here. de la Rue du Can et al. (2009) present a breakup of energy uses in 2005 and estimate levels of demand in 2020. The two sectors that were the largest users of energy in 2005 were residential households and industry (37 percent and 34 percent of primary energy respectively). But the type of energy used is different, as noted above; 50 percent of residential use was biomass production, which hardly features in the case of industry. Let us look at each of these uses separately.

Industrial Demand

According to de la Rue du Can et al. (2009), energy demand from industry is expected to grow faster than that from any other sector except transport. TERI predicts that, in a 'business as usual' scenario, by 2031 industry will consume 56 percent of all commercial energy production (with transport accounting for 31 percent and residential use only for 9 percent) along with 50 percent of all electricity production (as compared to 30 percent for residential use and 3 percent for transport) (TERI 2009). de la Rue du Can et al. (2009) note that 63 percent of energy consumption by industry is consumed by five energy-intensive industries; between 1990 and 2005, the consumption of energy by other industrial sectors barely increased, while that of these five sectors rose very sharply. These industries use

energy both in the form of electricity and through the direct use of coal. These five energy-intensive industries are iron and steel, cement, aluminium, ammonia and paper, with the first three representing the largest share.

Therefore, the sources of demand and the use of the products of these three industries—iron and steel, cement and aluminium—are indicators of the manner in which India's development process is using energy. It is striking first to note that in the case of all three products, the international market price is largely determined by the enormous demand from one market: China. For instance, in 2009 China consumed almost 60 percent of the entire world's iron ore production (Rutkowski 2010). What is driving the demand for these products in the Chinese market?

Again, the most common answer is 'growth.' But on closer examination, some disturbing points on the character of such growth—and specifically the aspects of it that are promoting use of these products—seem to emerge. In 2009, an estimated 90 percent of China's GDP growth was based on fixed asset investment (Chovanec 2010). Such investment primarily lies in real estate and infrastructure. Without available data it is difficult to estimate what kind of infrastructure was being constructed, but the picture on real estate has some warning signs. In 2010, a Chinese economist sought to estimate the number of flats that are unoccupied in the country by assessing electricity bills. He estimated that the total is a staggering 64 million empty flats. Wu et al. (2010) found that housing prices have increased 225 percent in the last decade; in 2009, moreover, housing prices were out of the reach of 85 percent of the population.

All of these are classic signs of an overheated speculative market, where investment is being made not because it is needed, but in order to take advantage of easy finance and credit. One estimate is that the Chinese 'housing bubble' is considerably larger than that of the U.S. at the time of the subprime crisis that, in turn, led to the 2008 world financial crisis (Miller 2011). It would not be surprising if the same is true of much of the rest of China's infrastructure investments, which are being driven by similar dynamics (*ibid*).

The second large market for these industries is the domestic one, where, once again, construction is presumably a major source of demand for all three industries. A look at the Indian market shows similar disturbing signs, though a speculative bubble may not be forming at the national level. No nationwide figures for vacant and unused real estate appear to exist, but in June 2011, an estimated 93,000 flats were vacant in Mumbai (Lewis 2011), while in early 2008 the Inspector General of Registrations estimated there would shortly be one lakh empty apartments in Bangalore (Kumar et al. 2008). Real estate prices in the country continue to be extremely high, and affordable housing is largely a mirage for most residents—especially those in urban areas.

This data is not conclusive, but it presents a dangerous indicator. It shows that a substantial proportion of India's industrial energy demand at present, and the fastest growing part of it, is being driven by dynamics that have little to do with the needs of the majority of Indians. The industries utilizing this energy and demanding more and more of it are producing goods—steel, cement, aluminium—that in turn are often being consumed in a manner that at most benefits a narrow segment of the population (in the case of Indian real estate) and at worst benefits no one but financial speculators (China's housing bubble). Moreover, in the case of speculative demand and bubbles, such demand follows boom and bust cycles that make both industries and economies vulnerable.

Finally, the industries that consume the most energy also tend to be the most damaging in other ways. Thus, the cement industry is not only a major consumer of energy; it is itself a contributor to climate change, with cement plants accounting for fully 5 percent of global emissions in 2007 (Rosenthal 2007). Cement also requires a large amount of coal, which provided 94 percent of its energy requirements in 1999 (Schumacher and Sathaye 1999). A major raw material for cement production is limestone, and limestone mining, in turn, is projected to require 131,310 hectares of additional land by 2021–22 (Singh 2011). Iron and steel production, the single largest energy consumer among industrial sectors, has similar impacts.

The Indian steel industry is the second largest consumer of coal in the country (Ghosh and Yasmin 2008), after thermal power plants, and Singh (2011) estimates an additional land requirement of 319,230 hectares by 2024–25 for iron ore mining. There is thus a very strong link between demand for the products of these industries and a range of destructive impacts on a huge population, who will then be rendered even more vulnerable to the devastation wreaked by climate change.

Residential Demand

The other sector with a projected rise in energy is the residential sector. This may appear more benign, since after all it is households that most directly suffer from energy shortages in this country. But once again, the mere fact that energy will be supplied to households does not mean it will be supplied to the households that require it. Indicative data in this respect too is disturbing. Most available data pertains to electricity, which is the main projected source of additional energy consumption by households.

First, the primary programme of the government that aims at ‘total electrification’ of the country is the Rajiv Gandhi Grameen Vidyutikaran Yojana, which was to complete its work by 2012. The Yojana was to ensure one Kwh of electricity per day to every household (Harish and Raghavan 2011), for six to eight hours of use (Sreekumar and Dixit 2011). This basic level of consumption was estimated to require a total capacity of 20,000 MW of electricity—approximately 12 percent of existing capacity (*ibid*). Even if one imagines that this capacity would entirely be drawn from new sources (as opposed to savings from transmission losses, etc.), the difference between this and the targets for increased power generation in India are striking. Indeed, as cited above, in just five years the Environment Ministry has granted clearance for land and resource use to additional plants that—on paper—can generate more than 10 times this capacity.

Moreover, even as generating capacity is increasing rapidly, the Yojana is most likely going to fail to meet its target. Supply in these

areas is irregular, repairs extremely slow, and electricity for this purpose is not being allocated (*ibid*). As noted above, even the Ministry of Power estimates that 28 million households will remain without any supply at all after the completion of the Yojana (Harish and Raghavan 2011). Aside from the Yojana, meanwhile, other data is consistent with this picture; between 1983 and 2005, while electricity consumption increased, the share of rural households dependent on biomass remained almost perfectly constant. Only the top 10 percent in rural areas showed a slight shift towards electricity (Pachauri and Jiang 2008).

Thus, those who have no electricity at all are likely to only marginally benefit from the enormous increase in generation capacity and energy supply that is planned. What of those who do? A study by the World Bank projected the maximum increase in energy demand from households over the next decade to be for heating and cooling purposes, and the majority of this from ACs—a luxury good consumed by a very small part of the population (World Bank 2008).

The very large effect of ACs on total power demand can already be glimpsed in interesting anecdotal data from Delhi—namely the drop in total power consumption that results from unseasonal dips of temperature in the summer season. Such temperature dips will have little effect on any other form of electricity consumption except cooling devices; would be unlikely to result in major drops in fan usage, since temperatures remain relatively high; and finally could not have resulted from switching off of non-discretionary AC use (such as in hospitals), as these ACs would have remained on. If temperature drops are reflected in changes in power consumption, then, a large part of this change will result from the switching off of domestic and office ACs.

It is then striking to note that on 17 April 2011, a drop of about 6–8 degrees in temperature led to a fall in Delhi's power consumption of fully 500 MW—15 percent of total consumption (Aradhak 2011). A similar dip in March 2009, along with the 'Earth Hour' (an exercise that again would only touch upper class households) led to a drop of 1000 MW, or more than a quarter of normal consumption (*Indian Express* 2009).

While, again, this is not a conclusive picture, the signs are clearly against the notion that additional energy flows in India are reaching those who need them.

3.3 Economic Policies, Energy Infrastructure and Ways Forward

Overall, the picture presented here raises a very disturbing possibility. Government policies are following an extremely destructive cycle:

1. Supporting industrial production driven by demand from a narrow elite and from financial speculators, both of whom receive an increasing share of national wealth as a result of neoliberal policies.
2. Projecting additional energy production to support these industries and elites;
3. Allocating enormous areas of land, minerals and other resources in order both to support industries directly and to provide industries and elites with energy.

In turn, all of these processes also produce considerable emissions and gravely exacerbate global climate change.

Thus, overall, economic policies, climate change and state action all converge on dispossession and displacement of a large number of people and result in increased vulnerability (in terms of health, livelihoods, employment and natural disasters) for the majority of the population. In exchange, these people receive nothing but rhetoric about 'development' and 'growth.'

Such a cycle is by no means inevitable. It has been created by conscious policies. The economics angle of these policies, and the alternatives, are out of the scope of this paper and have been dealt with at length elsewhere. In terms of energy production and use, however, certain pointers can be gleaned from this information. These are discussed in more detail in the conclusion.

Notes

1. Report generated from website of the Central Electricity Authority, www.cea.nic.in.
2. Website of the U.S. Energy Information Administration, Frequently Asked Questions; available online at <http://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11>.
3. For more on CARMA, see Wheeler et al. (2008).
4. GoI (2008); one should note that these figures do not quite add up, since 15 percent of 148,700 MW is only 22,300 MW, yet the government also shows an installed capacity of 36,000–38,000 MW of hydropower.
5. Report generated from website of the Central Electricity Authority, www.cea.nic.in.
6. See http://www.indianwindpower.com/policy_environment.php.

References

- Abbasi, Tasneem and S.A. Abbasi. 2011. 'Small Hydro could Add Up to Big Damage.' Available at <http://www.scidev.net/en/opinions/small-hydro-could-add-up-to-big-damage-1.html>.
- Aradhak, Purusharth. 2011. 'Rain Pours Cool Comfort, Delays Onset of Summer,' *Times of India*, 18 April.
- Asher, Manshi. 2011. 'Buying Silence, Manufacturing Consent,' 20 December. Available online at <http://infochangeindia.org/water-resources/features/buying-silence-manufacturing-consent.html>.
- Asian Development Bank (ADB), Global Environment Facility (GEF) and United Nations Development Programme (UNDP). 1998. 'Executive Summary,' *Asia Least-cost Greenhouse Gas Abatement Strategy*. India. October.
- Bank Information Center (BIC) and Sierra Club. 2011. *Move Beyond Coal, Now: Voices from the Front Lines of Global Struggle*, September.
- CSE. 2008. 'Rich Lands, Poor People: Is Sustainable Mining Possible?' *Sixth State of India's Environment Report*. New Delhi: Centre for Science and Environment.
- . 2011. 'System of Green Clearances Not Working for Environment and People and Clearances Not the Impediment to Growth, says CSE's New Study,' 22 September. Available online at <http://www.cseindia.org/content/system-green-clearances-not-working-environment-and-people-and-clearances-not-impediment-gro> (last accessed on 16 November 2011).
- Chovanec, Patrick. 2010. 'Two Reasons China's 12% GDP Growth is Bunk,' *Business Insider*, 16 April. Available at <http://www.businessinsider.com/chinas-gdp-growth-is-unsustainable-2010-4> (Last accessed on 26 December 2011).
- Climate Lab*. n.d. 'Natural Gas.' Available at http://climatelab.org/Natural_Gas. (Last accessed on 24 December 2011).

- Committee on Environmental Impacts of Wind Energy Projects (CEIWEP). 2007. *Environmental Impacts of Wind-Energy Projects* National Academies Press.
- de la Rue du Can, Stephane, Michael McNeil and Jayant Sathaye. 2009. *India Energy Outlook: End Use Demand in India to 2020*. Lawrence Berkeley National Laboratory.
- Deshmukh, Ranjit, Ashwin Gambhir and Girish Sant. 2010. 'Need to Realign India's Solar Mission,' *Economic and Political Weekly*, 20 March.
- Ghosh, Debyani, P.R. Shukla, Amit Garg and P.V. Ramana. n.d. 'Renewable Energy Strategies for India Power Sector,' Occasional Paper. New Delhi: Centre De Sciences Humaines.
- Ghosh, Soumitra and Hadida Yasmin. 2008. 'India's Energy Sector,' *Mausam*. September.
- GoI. 2008. *Hydro Power Policy 2008*. Ministry of Power. Available at http://powermin.gov.in/whats_new/pdf/new_hydro_policy.pdf (last accessed on 25 December 2011).
- . 2009. *Technology Action Plan: High Efficiency, Low Emissions Coal—Report to Major Economies Forum on Energy and Climate*. Prepared by the Governments of India and Japan, December.
- Greenpeace. 2010. 'Mining impacts.' Available at <http://www.greenpeace.org/international/en/campaigns/climate-change/coal/Mining-impacts/> (Last accessed on 24 December 2011).
- Harish, Santosh M. and Shuba V Raghavan. 2011. 'Redesigning the National Solar Mission for Rural India,' *Economic and Political Weekly*, 4 June.
- Himachal Live. 2010. 'Higher silt level shuts down SJVNL Power Project,' 20 July. Available online at <http://www.himachallive.com/higher-silt-level-shuts-down-sjvnl-power-project.html>.
- Indian Express. 2009. 'Earth Hour and weather effect: Power Demand Down 1000 MW,' *Indian Express*, 30 March.
- Jackson, Mike P. 2007. 'The Future of Natural Gas in India: A Study of Major Consuming Sectors,' Working Paper #65, Program on Energy and Sustainable Development, Stanford University. October.
- Kandhari, Ruhi and Aparna Pallavi. 2010. 'Biomass Market in a Flux,' *Down to Earth*, New Delhi: Centre for Science and Environment. 17 March.
- Kumar, B.S. Satish and Sharath S. Srivatsa. 2008. 'One Lakh Apartments May Remain Vacant in bangalore by April,' *The Hindu*, 20 February.
- Lazarus, Michael and Chelsea Chandler. 2011. 'Coal Power in the CDM: Issues and options,' Working Paper No. 2011–02. Stockholm Environment Institute. November.
- Lewis, Clara. 2011. 'Tax Vacant Flats to Boost Supply,' *Times of India*, 3 June.

- Mehdudia, Sujay. 2011. 'Jairam's Letter to Manmohan Spurs Jaiswal into Action,' *The Hindu*, 23 May.
- Miller, Steven. 2011. 'What If the China Bubble Bursts?,' *Time*, 17 October.
- Mitra, Naresh. 2011. 'Give a Dam,' *Times Crest*, 17 September.
- NFFPFW, NESPON and DISHA. 2011. 'The Indian CDM: Subsidizing and Legitimizing Corporate Pollution,' November.
- NRC. 2007. 'Backgrounder on Radioactive Waste,' 4 April. Nuclear Regulatory Commission (United States) Available online at <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html>.
- Pachauri, Shonali and Leiwen Jiang. 2008. 'The Household Energy Transition in India and China,' Interim Report, International Institute for Applied Systems Analysis. 19 May.
- Power Line*. 2009a. 'Hydro Power Development is a Complex Field,' Interview with S.K. Garg, Chairman, NHPC, *Power Line*. January.
- . 2009b. 'Meeting Targets: Solutions for Optimum Harnessing of Hydro Potential,' Interview with Jayant Kawale, Joint Secretary, Ministry of Power, *Power Line*. January.
- PTI (Press Trust of India). 2010. 'India Eyeing 63,000 MW Nuclear Power Capacity by 2032: NPCIL,' 11 October. Available online at http://articles.economictimes.indiatimes.com/2010-10-11/news/27616582_1_pressurized-heavy-water-reactors-fuel-cycle-indian-nuclear-society.
- Ramana, M.V. and C. Rammanohar Reddy. 2003. *Prisoners of the Nuclear Dream*. Delhi: Orient Longman.
- Rao, Narasimha, Girish Sant, and Sudhir Chella Rajan. 2009. *An Overview of Indian Energy Trends: Low Carbon Growth and Energy Challenges*, Pune: Prayas Energy Group.
- Rosenthal, Elizabeth. 2007. 'Cement Industry is at Center of Climate Change Debate,' *New York Times*, 26 October.
- Rutkowski, Ryan. 2010. 'China's Battle for Iron Ore,' *Asia Times*, 6 May.
- Schumacher, Katja and Jayant Sathaye. 1999. *India's Cement Industry: Productivity, Energy Efficiency and Carbon Emissions*. Ernest Orlando Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division.
- Singh, Yudhvir. 2011. Presentation to National Consultation on Takeover of Common Lands, Society for Promotion of Wastelands Development, July.
- Sreekumar, N. and Shantanu Dixit. 2011. 'Challenges in Rural Electrification,' *Economic and Political Weekly*, 46(43). 22 October.
- Suchitra, M. 2011. 'India: Green Energy Project Destroys Green Cover,' *One World South Asia*, October 4.
- Teltumbde, Anand, Sanjay Dabhade, Akram Siddiqui, S Ansari. 2007. 'Unclean Intrigues Behind Clean Energy: Dhule Adivasis' Glorious Struggle for Land

- Rights,' Fact Finding Report, Committee for Protection of Democratic Rights. August.
- TERI. 2004. *Energy Data Directory and Yearbook 2003/2004*. Delhi: The Energy Research Institute.
- Thakkar, Himanshu. 2007. '19% of India's Global Warming Emissions from Large Dams,' Press Release, New Delhi: South Asian Network on Dams, Rivers and People.
- . 2009. 'There is Little Hope Here—Report on India's National Action Plan on Climate Change,' Press Release. New Delhi: South Asian Network on Dams, Rivers and People.
- UN-OCHA. 2004. 'Press Statement: Chernobyl: Needs Remain Great 18 Years after Nuclear Accident.' United Nations Office of Coordination of Humanitarian Affairs (UN-OCHA), United Nations, 26 April. Available online at <http://www.un.org/News/Press/docs/2004/iha896.doc.htm>.
- Vidal, John. 2011. 'Andhra Pradesh at the forefront of Indian "Coal Rush,"' *The Guardian*. 14 July.
- Wheeler, D. and K. Ummel. 2008. 'Calculating CARMA: global estimation of CO₂ emissions from the Power Sector.' Center for Global Development, Working Paper 145.
- World Bank. 2008. 'Residential Consumption of Electricity in India: Documentation of Data and Methodology,' Background Paper Draft, July. World Bank. Available at <http://moef.nic.in/downloads/public-information/Residentialpowerconsumption.pdf>. (Last accessed on 24 December 2011).
- WISE. 2008. *Power Drain: Hidden Subsidies to Conventional Power in India*, WISE Research Report. Pune: World Institute of Sustainable Energy.
- Wu, Jing, Joseph Gyourko, Yongheng Deng. 2010. 'Evaluating Conditions in Major Chinese Housing Markets,' Working Paper 16189, National Bureau of Economics Research. July.
- Yablokov, Alexey, Alexey Nesterenko and Vassily Nesterenko. 2009. *Chernobyl: Consequences of the Catastrophe for People and the Environment*. New York: New York Academy of Sciences.
- Zweibel, Ken. 2010. 'Land Needed To Make All Our Electricity with Solar Photovoltaics,' *The Solar Review*. Available online at <http://thesolarreview.org/2010/01/28/land-needed-to-make-all-our-electricity-with-solar-photovoltaics/> (last accessed on 26 December 2011).

4

Mitigating Climate Change

The Indian way

Soumitra Ghosh

4.1 What is Mitigation?

In today's climate jargon, the word 'mitigation' stands for action/actions that aim at reducing or diffusing the threat of global warming. Because global warming is caused mainly by carbon dioxide and other greenhouse gases being released into the earth's atmosphere, it is reasonable to assume that any 'mitigating' action will aim at reducing the emitted quantity of these gases; in other words, it will ensure that a much reduced amount of GHG gets released, in comparison to the scenario before the action has been taken. This, in turn, means first identifying and then assessing the human activities that cause GHG emissions, and then either stopping—at least reducing the scale of—such activities. It can also mean taking necessary steps, technological, economic, environmental and otherwise, to guarantee that the GHG-emitting activities are conducted in such a way that the intensity and level of emissions come down.

Therefore, mitigation is the second key word in the climate discourse (the first is adaptation, or admitting that climate change is irreversible, and hence we need to adapt ourselves to the changed

climate). It is useless to argue about which comes first. Because climate change exists, there will always be a rapidly escalating need for quick, effective, economically and socially responsive adaptation measures that will attend to the vulnerable communities most; but at the same time it is necessary to definitively and immediately bring down existing global emission levels so that the threat of global warming can be reasonably contained, and the earth's environment doesn't become too inhospitable to allow species survival.

More than adaptation, however, mitigation concerns dominated the Kyoto Protocol and other past climate treaties: the agreements ostensibly tried to kick-start a process whereby governments and peoples of the earth can work together in order to effectively contain—or keep at bay—the imminent danger for a longer period. This, as discussed in the earlier chapters, did not happen either globally or at the national level; the world's climate has continued to become more erratic and unpredictable, and every passing day the threat to billions of people's lives has become yet more palpable and real. It is easy to understand why this has happened. None of the human activities that cause global warming have changed enough in the last one-and-a-half decades since the Kyoto Protocol came into being to make a difference, despite the very visible Conferences of Parties and the pledges and commitments expressed therein.

'Mitigating' climate change, in real, physical terms, did not take place as emission levels have continued to go up instead of coming down, and both fossil fuel burning and deforestation—the two largest anthropogenic sources of GHG emissions—have continued unabated. In fact, the pursuance of the market-driven neoliberal model of economic growth has resulted in an alarming increase in both, and therefore, in emissions, particularly in a country like India, as seen in the preceding chapter.

Yet, Indian submissions in the various CoPs and to the UNFCCC continue to talk of substantial emission reductions. These reductions, according to the Indian government, have taken place mainly through its Clean Development Mechanism (CDM) projects and through the new Renewable Energy Trading (RET) projects, both of which

promote energy efficiency in existing energy-intensive sectors like industry—in addition to promoting a gradual switch-over to renewable sources of energy—as well as effective conservation of forests. The National Action Plan on Climate Change (NAPCC) of 2008, the first-ever such official action plan in India, lists both adaptation and mitigation measures that the government says it already has taken up or will take up in the near future. A separate paper appended to this study (Annexure 2) deals with the NAPCC more thoroughly; here we briefly comment on some key mitigation actions.

Development but No GHG Mitigation: The NAPCC

Why did the NAPCC happen? According to the Plan, it ‘responds to the decision of the PM’s Council, as well as updates India’s national programmes relevant to addressing climate change.’ It goes on to clarify that it ‘identifies measures that promote our development objectives, while also yielding co-benefits for addressing climate change effectively. It lists specific opportunities to simultaneously advance India’s development and climate related objectives of both adaptation as well as greenhouse gas (GHG) mitigation’ (GoI 2008).

The agenda is clearly visible: while India’s development cannot be compromised, the ‘opportunities’ in climate issues will be tapped. Development here means the resource, energy and capital-intensive neoliberal growth that India has been pursuing since 1991, and the ‘opportunities’ are obviously business opportunities. A climate change action plan finally appears, but it admits that the priority is to keep development going, not to take any definitive and tangible mitigation actions that are likely to affect it adversely (*ibid*):

India’s development agenda focuses on the need for rapid economic growth. Meeting this agenda requires large-scale investment of resources in infrastructure, technology and access to energy. Only rapid and sustained development can generate the required financial, technological and human resources. In view of the large uncertainties concerning the spatial and temporal magnitude of climate change impacts, *it is not desirable to design strategies exclusively for responding to climate change.*

Rather, the need is to identify and prioritize strategies that promote development goals....

It is imperative to identify measures that promote our development objectives, while also yielding co-benefits for addressing climate change effects. Cost-effective energy efficiency and energy conservation measures are of particular importance in this connection. Similarly, development of clean energy technologies, though primarily designed to promote energy security, can also generate large benefits in terms of reducing carbon emissions. Many health-related local pollution controls can also generate significant co-benefits in terms of reduced greenhouse gas emissions...

It also describes India's willingness and desire, as a responsible member of the global community, *to do all that is possible for pragmatic and practical solutions for all, in accordance with the principle of common but differentiated responsibilities and respective capabilities...* (emphasis added)

In view of such pre-conditions, the scope of mitigation actions automatically becomes shallower. According to the Indian government, mitigation means:

...measures to reduce the emissions of greenhouse gases that cause climate change in the first place, e.g., by switching to renewable sources of energy such as solar energy or wind energy, or nuclear energy instead of burning fossil fuel in thermal power stations (*ibid*).

The plan goes on to make the usual claims about forest sinks:

...an aggressive afforestation and sustainable forest management programme resulted in annual reforestation of 1.78 mha during 1985–1997, and is currently 1.1 mha annually. Due to this, the carbon stocks in Indian forests have increased over the last 20 years to 9–10 gigatons of carbon (GtC) during 1986 to 2005.

Hollow Claims about Mitigation

'India has in place a detailed policy, regulatory, and legislative structure that relates strongly to GHG mitigation,' the NAPCC claims. It says that the Integrated Energy Policy adopted in 2006 has provisions for mitigation: promotion of energy efficiency in all sectors, emphasis

on mass transport, emphasis on renewables including biofuel plantations, accelerated development of nuclear power and hydropower for clean energy, focused R&D on several clean energy related technologies and market reforms. It further says that:

The National Environment Policy, 2006, and the Notification on Environment Impact Assessment (EIA), 2006, reform India's environmental assessment regime. A number of economic activities are required to prepare environment impact assessments, and environment management plans, which are appraised by regulatory authorities prior to start of construction. The EIA provisions strongly promote environmental sustainability.

Surprisingly, the plan suggests only a few vague and general actions in support of these tall claims: it talks about secondary things like an 'energy labelling programme for appliances,' an 'energy conservation building code,' 'promotion of energy saving devices' like CFL lights, and 'energy audits of large industrial consumers,' all randomly listed without bothering to explain regulation and enforcement. It goes on to list routine mass transport development as mitigation, and describes the recent partial switch-over to CNG in some Indian metros as a 'clean air initiative,' without adding that the switch-over happened mainly as a result of tenacious judicial activism by environmental groups (rather than as a result of the government's climate policies).

The Plan presents eight separate national climate missions (see Annexure 2), among which the mission for 'enhanced energy efficiency in industry,' renewables and the 'Green India Mission' are prominently listed as potential mitigation actions. We will look at the Green India Mission and renewables later in this chapter; first we briefly explore the energy efficiency mission.

Energy Efficiency Mission: Making a Case for CDM

Typically indeterminate and lacking in specificity, the Energy Efficiency Mission says that, while Indian industries are as a rule

energy-efficient, 16 percent of total industrial emissions can be reduced through adoption of energy efficiency measures like 'sector-specific technological options,' 'cross-cutting technological options' and 'fuel-switch.' It explains little beyond this. For instance:

3.2.2. SECTOR SPECIFIC TECHNOLOGICAL OPTIONS

Various GHG mitigation technology options in respect of the Chlor-Alkali, Cement, Aluminum, Fertilizer, Iron and Steel, Pulp and Paper, and Textile sectors are currently being investigated.

3.2.3. CROSS-CUTTING TECHNOLOGICAL OPTIONS

Apart from sector-specific options, there are certain cross-cutting energy efficient technological options that could be adopted in a wide range of industries. In general, in the industries sector, approximately 50% of the industrial energy use is accounted for by cross-cutting technologies.

The estimated energy saving potential for a large number of plants is of the order of 5% to 15%.

The NAPCC says nothing about precisely how the 16 percent reduction will be achieved. Beyond stating that new technology options, including technology transfer options, will be explored, it only talks about the need for providing more 'fiscal incentives' in the form of subsidies to the industries opting for energy-efficient measures. It is said that an 'Energy Efficiency Financing Platform' will be set up, and the rest of the funding will come from carbon finance. It needs to be remembered that the presence of carbon finance automatically excludes all other forms of financial incentives. Under existing agreements, if an energy efficiency project in an industry has to seek carbon finance, it has to first conclusively prove that no other financial support is in place, and that the project can happen only through the provision of carbon finance.

There is thus, a tacit assumption in the Plan that Indian industries will take to energy efficiency in a big way. The lure of carbon money was strong enough in 2008, when carbon prices peaked in the global offset market. Regulations were deemed unnecessary in this context; rather, it was assumed that the existing environmental laws in the

country would be adequate to ensure compliance. It will be pertinent to note here that CDM project approval in India does not require environmental clearances, and hence such projects have no mandatory need to submit Environment Impact Assessments (EIA) or Environment Management Plans (EMP). Even in cases where an industrial or infrastructure project has to go through the EIA process, law enforcement often takes a backseat in favour of the 'rapid economic development' of the country, as all those remotely familiar with the Indian scene know. The preceding chapter also discussed how Indian industries in general, and the energy sector in particular, routinely displace and destroy both people and the environment in pursuance of their agenda of rapid growth. As a result, the industrial mitigation scenario in India largely and essentially is the continuance of the same sordid story of lies, deceit, deprivation and misery. A look at the Indian CDM projects—which at present constitute the bulk of Indian 'mitigation' actions—makes that clear.

Other Missions: Biofuel and Biotechnology

The Agriculture Mission talks mainly about biotechnology; without mentioning a single time that the biotechnological climate solutions currently being suggested are all highly controversial. The mission says that its priority areas include use of genetic engineering:

- Use of genetic engineering to convert C-3 crops to the more carbon responsive C-4 crops to achieve greater photosynthetic efficiency for obtaining increased productivity at higher levels of carbon dioxide in the atmosphere or to sustain thermal stresses.
- Development of crops with better water and nitrogen use efficiency which may result in reduced emissions of greenhouse gases or greater tolerance to drought or submergence or salinity.

There is no reference to the possible ill-effects of such genetically engineered crops on the country's ecological landscape as a whole, and the threat to local biodiversity in particular.

Further, the NAPCC offers biofuel plantations as another climate solution. The plan ignores the fact that commercial cultivation of

biofuels like *Jatropha* on a large scale have already started affecting the food security of the country and can only happen at the cost of millions of rural livelihoods and long-term ecological sustainability (Lahiri 2008).

Mitigation in India thus translates into the government and business leaders grabbing opportunities. By its own admission, the Indian government thinks that only those actions which make good business sense make good mitigation actions; hence the emphasis on market mechanisms like CDM and RET.

Carbon Trading in India: The Clean Development Mechanism (CDM) and Renewable Energy Trading (RET)

Much has been written on the rapid growth of CDM in India,¹ mainly by the promoters and developers of CDM of course, but also by critics of the process (Lohmann 2006; Böhm and Dabhi 2010; *Mausam*; and NFFPFW et al. 2011). We need not go into the statistical details of the CDM scenario in India here, apart from mentioning that India presently has about 1850 CDM projects at various stages of registration.² This is roughly 24 percent of the global total, and second only to China. Together, these projects claim to reduce about 411 million tonnes of greenhouse gases by 2012 (the end of the first Kyoto Commitment period), and a cumulative total of 1716 million by 2020 (if Kyoto is extended up to that point). This is 15.1 percent of the projected global total reductions from CDM; in this again India is second to China's whopping 54 percent, coming mainly of course from its hydrofluorocarbon or HFC, large coal-fired power plants and hydroelectric projects.

CDM in India: Mitigation at a Domestic Level?

The Indian government—particularly the Ministry of Environment and Forests (MoEF)—routinely boasts of its CDM kitty, and points to carbon trading not only as a foreign exchange earning option but as a way to mitigate the country's domestic emissions as well: "This

is the potential foreign direct investment (FDI) that India stands to earn from carbon credits. In fact, 10 percent of India's annual greenhouse gas (GHG) emissions can be neutralized because of this,' said Jairam Ramesh, the then Environment Minister of the country, in December 2009 (D'Monte 2009). He also boasted of the 28,000 crore windfall that the country stands to gain from CDM projects (*ibid*). Elsewhere, too, government agencies cite CDM as a domestic and internal mitigation process: the Integrated Energy Policy Report makes a similar kind of claim, while talking of 'Climate Change Concerns:'

Concern vis-a-vis the threat of climate change has been an important issue in formulating the energy policy. Even though India is not required to contain its GHG emissions, as a signatory to the UN Framework Convention on Climate Change and a country which has acceded to the Kyoto Protocol, India has been very active in proposing Clean Development Mechanism (CDM) projects. By May 2006 (the Report was released in 2006), a total of 297 projects had been approved by India with approximately 240 million tonnes of CO₂ reduction. (Planning Commission 2006)

Another MoEF brochure, released in 2010, lists 24 adaptation/mitigation initiatives, and includes CDM among these:

14. CDM Programme: India assessed as Best CDM Country; Indian projects to neutralise 10% of emissions by 2012. (Planning Commission 2006)

But can India claim at all that the CDM projects it hosts reduce its domestic emissions? Definitely not, because the whole concept of the clean development mechanism rests on the premise that reduction in emissions in the countries of the global South are used to *offset* those of the global North (who then pay for this offsetting by purchasing carbon credits). Thus, the notion behind CDM is that the Annex I countries from the global North will transfer and promote low-carbon clean technologies to the countries in the global South, and in return will be entitled to cuts in their obligatory Kyoto compliance targets:

2. The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3.
3. Under the clean development mechanism:
 - (a) Parties not included in Annex I will benefit from project activities resulting in certified emission reductions; and
 - (b) Parties included in Annex I may use the certified emission reductions accruing from such project activities to contribute to compliance with part of their quantified emission limitation and reduction commitments under Article 3, as determined by the Conference of the Parties serving as the meeting of the Parties to this Protocol. (UN 1998)

Thus, to count CDM projects as reducing India's emissions amounts to counting emissions reductions twice—once in the name of the Annex I country which pays for them, and once in India's own name. This is obviously an absurdity.

In more detail, the carbon credits generated by the 'clean projects' set up under CDM will accrue to the Annex I countries if brokers and corporations from those countries purchase them, in order to comply with their own emission reduction targets. The credits from CDM projects cannot be traded inside the country which hosts them, going by the present rules of the CDM regime. This, in turn, means that if there is any mitigation in CDM that is actually happening in countries who buy carbon credits, and not in countries where they supposedly happen, if one accepts the bizarre logic of carbon trading.

*The Reality of Indian CDM:
Examining the Myth of Sustainable Development*

'India may be the second-largest country in terms of the number of CDM projects (after China) but it is the best in terms of implementing them,' Ramesh claimed further in his 2009 speech (D'Monte 2009). Apart from offsetting and thus mitigating emissions in the North, the

CDM's objectives prominently include promoting sustainability in the South. This is why CDM has repeatedly been called a 'win-win' scenario; not only because does it supposedly help reduce production of GHGs that cause global warming, but it also claims to promote socially and environmentally sustainable 'clean development' in countries where CDM projects come up.

4.2 Defining and Assessing Sustainable Development

The New UNFCCC Study

But what is sustainability? How does one define sustainable development? After roughly a decade or so of promoting CDM in various developing and not-so-developed countries of the world, the UNFCCC has declared that it is not sure about what constitutes sustainability, especially in a CDM project:

...there is still no universally accepted definition of sustainable development or an agreed basis for determining whether a specific action, such as a proposed CDM project, would contribute to sustainable development.

In the recently released report called *Benefits of the Clean Development Mechanism 2011*, the UNFCCC however clarifies that:

...it is widely agreed that sustainable development comprises of three mutually reinforcing dimensions, namely economic development, social development, and environmental protection.

The report does not explain how one defines economic and social development in an extremely unequal and badly divided world, and does not define the term 'environmental protection.' It then goes on to admit that, despite this 'wide agreement,' there is no 'accepted international definition of sustainable development' (italics added), and hence the 'responsibility for determining whether a CDM project contributes to national sustainable development as defined by the host country currently resides with its designated national author-

ity (DNA).’ For instance, a CDM project in India becomes an example of ‘sustainable development’ if the National CDM Authority (NCDMA) set up under the MoEF says so. The authority has to simply issue an approval letter and state that, *‘in its judgment, the proposed CDM project will contribute to the country’s sustainable development.’* The Designated Operational Entity (DOE) associated with the project will ensure that the letter is provided. Beyond this, the UNFCCC has no independent tool mechanism to assess the ‘sustainable development’ claims of a project (the utterly confusing report keeps repeating this):

Assessing the contribution of the CDM in assisting host countries in achieving sustainable development is challenging for the same reason—the lack of an agreed operational definition.

For the limited purposes of the report, nonetheless, the authors have developed a set of indicators to assess two things:

- How a CDM project contributes to sustainable development; and
- How much a CDM project contributes to sustainable development.

How were the indicators developed?

As yet there is no agreed list of indicators suitable for CDM projects... a set of 15 indicators was empirically derived from a representative sample of 350 CDM projects. These... cover the economic development, environmental protection and social development dimensions of sustainable development... The descriptions attempt to clearly distinguish the different indicators so that claimed benefits can be assessed consistently. The sustainable development claims in the PDDs of 2250 of the projects registered as at 31 July 2011 were tabulated.

A footnote goes on to add that:

The 2250 projects provide good coverage of all host countries and project types. No verification of the claims made in the PDDs was undertaken.

Thus, the indicators for the UNFCCC study were developed mainly on the basis of the claims made in the PDDs (and a few other previous studies), and assessed solely on the data given in the PDD. According to the study, the CDM projects covered in it collectively made the following sustainable development claims:

TABLE 4.1: Assessing Sustainable Development in CDM: UNFCCC Indicators

Economic	Direct/indirect financial benefit for the local and/or regional economy; Local/regional jobs generated directly/indirectly; Development/diffusion of local/imported technology; Investment in the local/regional infrastructure.
Environment	Efficient utilization of natural resources; Reduction in noise, odours, dust or pollutants; Improvement and/or protection of natural resources; Available utilities; Promotion of renewable energy.
Social	Labour conditions and/or human rights; Promotion of education; Health and safety; Poverty alleviation; Engagement of local population; Empowerment of women, care of children and frail.

Using these indicators, the study has measured the sustainable development claims made by more than 2000 ongoing CDM projects. The Indian projects, the study found, claim to have contributed to ‘engagement of local population’ and ‘poverty alleviation,’ apart from generating ‘local/regional jobs directly/indirectly,’ and reducing ‘noise, odours, dust or pollutants.’

It needs to be remembered that a CDM project in India needs to specify its contribution towards ‘four well beings’ (social, economic, technological and environmental) in order to qualify as CDM. The Indian NCDMA lists four sets of indicators to define ‘sustainable development.’³

The CDM should also be oriented towards improving the quality of life of the very poor from the environmental standpoint.

Following aspects should be considered while designing CDM project activity:

1. Social well being: The CDM project activity should lead to *alleviation of poverty by generating additional employment, removal of social disparities* and contribution to provision of basic amenities to people leading to improvement in quality of life of people.
2. Economic well being: The CDM project activity should bring in additional *investment consistent with the needs of the people*.
3. Environmental well being: This should include *a discussion of impact of the project activity on resource sustainability and resource degradation, if any, due to proposed activity; biodiversity friendliness; impact on human health; reduction of levels of pollution in general;*
4. Technological well being: The CDM project activity should lead to transfer of environmentally safe and sound technologies with a priority to the renewables sector or energy efficiency projects that are comparable to best practices in order to assist in upgradation of technological base. (italics added)

The UNFCCC study says clearly that it did not verify the claims made in the PDD. But how do the NCDMA, who claim that it is their prerogative 'to confirm whether a Clean Development Mechanism project activity assists' the host country 'in achieving sustainable development,' ensure that a project is measured against these indicators before being approved?

The answer is that it does not. Sustainable development claims from even chronically polluting industrial projects applying for CDM status are taken on face value; that is, claims made in the PDDs that the project developers submit are automatically taken to be true, without verification. When one considers that a CDM project does not have to enclose any environmental impact assessment (EIA) report with its PDD, and there is no way that the NCDMA can otherwise confirm the claimed sustainable development is actually happening, this sounds absurd. Nonetheless, it is true.

Utterly False Claims of Sustainable Development

In recent years it has often been pointed out that that CDM projects in India do not support sustainable development. *Down to Earth*, the premier environmental magazine of India, published a report on Indian CDM in 2005 (*Down to Earth*, 15 November 2005). The report covered several large and medium CDM projects in western and southern India, and, on the basis of field visits and PDD analysis, raised some important questions. In particular, the report asked why CDM projects should be treated differently than ordinary industry projects (in terms of being exempted from conducting and submitting statutory EIAs as a prerequisite for environmental clearance), and how do projects with known/potential environmental impacts get certified/validated/approved? The report also asked why PDDs from widely different projects should read like cut-paste copies of the same document, and indicated the possibility of large-scale fraud.

Since then several other reports and studies have examined the sustainable development claims of Indian CDM projects, and have found them to be manifestly false. The hydrofluorocarbon GFL project, one of the largest of all CDM projects worldwide (both in terms of claimed volume of emission reduction and with respect to financial profits made from CER sales), was found to have been polluting the air as well as all the water in and around its plant. This pollution did not diminish after it was certified as a CDM project in 2005. In 2009, extensive tests by an independent laboratory, conducted on behalf of the *Daily Mail*, UK, showed dangerous contaminants in the land and water around the factory—chemicals that match the pollutants produced by GFL.⁴ The newspaper found further that local people's livelihoods and health had been severely affected by the project, but the auditors (the DOE or the validating agency) who were supposed to verify the carbon savings checked only for abatement of greenhouse gases, caring little about other pollution. Another large CDM project in a steel plant owned by the

Jindal group (known as JSW or Jindal South West factory) in Bellary, Karnataka, has been similarly accused of air and water pollution by the villagers of Toranagallu, where the plant is located (Hannon 2009; *Mausam* 2&5). Besides the pollution, the villagers in both the GFL and the JSW areas complained about a range of malpractices and broken promises; it was alleged that both companies didn't keep their promises of rural development and creating jobs for the local people.

The GFL and JSW cases are part of a general pattern: a recently released report (November 2011) about Indian CDM projects by the Indian social movement NFFPFW (National Forum of Forest People and Forest Workers), in association with environmental NGOs NESPN (North Eastern Society for Protection of Nature and Wild Life) and DISHA (Direct Initiative for Social Health Action) reveals that irrespective of sector and size (both large and small industrial projects, including the biomass power projects and renewables like wind power and both large and small hydro as well as large industrial projects), Indian CDM projects display a surprising uniformity in adverse community level impacts (Lohmann 2006; Böhm and Dabhi 2010; *Mausam*; and NFFPFW et al. 2011). Instead of promoting sustainable development, they cause air and water pollution, displace people from their lands and livelihoods and destroy or enclose commons like forests, agricultural fields and pastures. Not a single project the study examined was found to yield any discernible benefit for the local economy, society or the environment. The projects generated no new jobs apart from a few temporary security guard posts here and there, and all talks of corporate social responsibility disappeared once a project got going.

The 2011 report, along with other studies published in *Mausam*, the e-magazine run by the same groups, reveal other startling facts about Indian CDM projects. Large Indian corporations like Jindal, the Tatas, Reliance, SRF, ITC and Suzlon dominate the CDM scenario in India, these studies say, and such unhealthy domination extends even to the so-called small-scale CDMs in the renewable energy sector. For instance, the energy

major Suzlon, who acquired the German power company RWE, controls wind energy CDM projects in India; first they set up wind turbines (otherwise known as wind energy generators or WEGs) in village commons or private lands and then sell those to companies wanting entry into the renewable and CDM business. The land is acquired entirely by Suzlon, often under false pretences (land in lieu of jobs, community development, etc.), and by intimidations and threats if necessary.

The 2011 NFFPFW study points out that the companies engaged in CDM are making huge profits. Till early 2008, the Jindal group made 11 billion rupees (and perhaps more) from 1.3 million CERs due to supposedly 'reduced emissions' at their steel plant in Karnataka.⁵ Tata Motors sold 163,784 CERs from clean wind projects at 15.7 euro per CER in 2007.⁶ Three separate CDM projects by Essar Steel in their Hazira Plant will yield no less than a staggering 40 million euro in 10 years from a 2009 pre-sale to a Danish utility company called Nordjysk Elhandel A/S.⁷ In 2006–7 alone, the GFL's earnings from carbon money were about twice its total sales turnover in the pre-CER issuance scenario,⁸ and the company's stocks went up considerably once the credit issuance started in 2007.⁹ Another HFC major, SRF of Rajasthan, stands to gain 300 million pounds from British oil companies like Shell (*The Sunday Times* 2007). Among the other major companies, Reliance now claims that they will earn a minimum of ₹3100 crore by selling CERs from their ultra-mega coal power projects at Sasan (already registered with UNFCCC) and Krishnapatnam.¹⁰

There seems to be no regulatory authority to look after CDM projects in India, the study concludes:

Projects are accorded approval solely on basis of paperwork they submit; it is taken for granted that a project applying for CDM status is automatically clean and sustainable; no matter if it fouls up the atmosphere and local people's lives with fly ash and smoke, displaces people and their traditional livelihoods through mostly illegal land grab and ritually breaks every little promise of employment and area development made to the communities.

The Indian CDM projects are, thus, not promoting sustainable development. But are they reducing emissions as claimed?

4.3 Emissions Reduction through CDM in India: Non-Additional, Fraudulent Projects

The main problem with the CDM projects' tall—and immensely profitable—claims of reducing GHG emissions is that there is no credible and definitive way to verify these claims. The validating agency is an organization paid by the project, and it gets paid to prove that the project is doing what it claims to do, and not otherwise. The result is that dirty and utterly ineligible projects sail through and make money. The biggest instance of this is the waste heat-based energy projects, mostly located in various sponge iron plants, which produce a form of soft and porous iron usually used in the construction industry. These projects are legally required to operate a machine called an electrostatic precipitator (ESP) to ensure that the smoke emitted by the plants is reasonably free from carbon particles. Because an ESP is an expensive machine to run, the plants seldom operate it. With the ESPs remaining inoperative most of the time, the waste heat project, dependent on the continuous running of the ESP machine, does not work. That the ESPs do not run is known to everybody: the State Pollution Control Boards, the villagers near the plants and the workers. This neither stops the government from approving these projects CDM claims, nor their validators from validating them (Juneja 2011; and NFFPFW et al. 2011).

Instances of irregularities and fraud are not confined to sponge iron; they cut across sectors. Several large thermal power plants in India have applied for CDM status of late, and two of them are already registered with UNFCCC (the Tiroda Plant by the Adani group and the Sasan plant by Reliance) despite complaints of large-scale land grab and rampant pollution at the project sites in Maharashtra and Madhya Pradesh (NFFPFW et al. 2011; and *Mausam* 2&5).

There is also concern about additionality. Back in 2006, Axel Michaelowa (2006), an academic and a carbon trading expert,

studied the PDDs of 52 Indian CDM projects. He found that Indian project developers had failed to demonstrate the additionality of their projects. In other words, they could not sufficiently and clearly establish that the emission reductions their projects had claimed to achieve were additional, meaning that these reductions would not have happened anyway even in the absence of the new technology and money that CDM brought. The study showed that the UNFCCC approval for the JSW project at Toranagullu was obtained by falsifying additionality data; 'the company accounting tricks' ensnared 'the EB,' Michaelwoa said.

It has been argued that the most of the renewable CDM projects in India are clearly non-additional: both wind energy and biomass projects benefit particularly from the existing tariff plan under which they sell electricity to the Indian national power grid, and generally from the overall subsidy regime in place (*Mausam* 1; Lohmann 2006; Böhm and Dabhi 2010; and NFFPFW et al. 2011).

Besides, there is the factor of hidden or disguised emissions. The waste-to-energy projects do not include in their PDDs biogenic and other emissions that waste burning in their projects cause. Similarly, the biomass projects fail to count the emissions resulting from switch-over to coal whenever raw material is scarce (a standard technique in most such plants).¹¹

The biggest instance of CDM projects hiding their in-situ or internal emissions figures, however, is the ultra-mega coal-fired power plants using supercritical technology. It has been alleged that not only do the PDDs of such projects use incorrect baselines to show inflated emission reduction, but they also hide important emissions data (Sierra Club and CDM WATCH 2011).¹²

The Fraud in Indian CDM Proved: The Wikileaks Revelation

That the fraud taking place in Indian CDM projects is both widespread and well known is also borne out by a recent Wikileaks revelation. In September 2011, Wikileaks released a cable the American Consulate in Mumbai had sent to the Secretary of State in July 2008,

summarizing a meeting that the Consulate's Office and the U.S. Governmental Accountability Office (GAO) had with Indian industrialists regarding their views and experience with the CDM.¹³ The cable provided clear evidence that non-additional projects are being supported, and that all the usual stakeholders are aware of this.

R.K. Sethi, Member Secretary of the National CDM Authority in India and then-Chairman of the CDM Executive Board, admitted that India's National CDM Authority 'takes the "project developer at his word" for clearing the "additionality" barriers.' Mathsy Kutty of Det Norske Veritas (DNV), a CDM Executive Board accredited validating agency and a known name in the CDM business circuit, said that: 'the designated authorities of host countries approve projects in a cursory manner and do not check to see whether the project meets all the requirements laid down by the CDM Executive Board.' Somak Ghosh, President of Corporate Finance and Development Banking at Yes Bank, made things even clearer: 'Project developers prepare two balance sheets to secure funding: one showing the viability of the project without the CDM benefit (which is what the bank looks at) and another demonstrating the non-viability of the project without the CDM benefit,' because 'no bank would finance a project which is viable only with carbon revenues because of the uncertainty of the registration process, unclear guidelines on qualifying CDM projects and because carbon revenue is only a by-product revenue stream of the main operations of the company.'

The Wikileaks cable officially confirmed what social movements in India have been saying for the last several years: CDM is a colossal scam, and there's nothing even remotely environmental about it. It has got nothing to do with climate change, other than the fact that climate change provides a new business opportunity to the corporations and people doing CDM. Because it is business, it can be unethical with impunity, and can afford to violate the rules of what has in any case been an extremely questionable game to start with.

Not deterred by such criticisms, however, the Indian government continues to promote the carbon market. It does not appear to matter that the market is now in total disarray, with prices of UNFCCC certified credits plummeting to a record low in late 2011. Keeping in mind the economic need for the essentially perverse incentive CDM has been providing the Indian businesspersons, and also partly perhaps to show to the world that it takes its mitigation targets seriously, India has now entered a second (and from a business perspective, apparently more secure) phase of carbon trading. This is called Renewable Energy Trading.

4.4 Free Market Carbon Trading in India: The Trade in RECs

Renewable energy certificate (REC) trading, or the Indian carbon trade in renewable energy, started in 2011, ostensibly to encourage the renewable energy generators in the India. On the face of it, the idea is to create a secure market for renewable power, and to ensure that a certain amount of power coming from the renewable projects flows regularly to the national power grid, as stipulated in the National Action Plan on Climate Change (NAPCC):

- 1.2: Contribution of renewable energy sources in the total portfolio of capacity as well as gross generation is still very low. As on 31st July, 2009, the renewable energy sources constituted only about 8.5% of the total generation capacity in the country. In terms of actual generation, the share of renewable is estimated to be in the range of 3.5% of the total generation.
- 1.3: The National Action Plan of Climate Change (NAPCC) has set the target of 5% renewable energy purchase for FY 2009–10 which will increase by 1% for next 10 years. The NAPCC further recommends strong regulatory measures to fulfill these targets.
- 1.7: It is in this context that the concept of Renewable Energy Certificate (REC) assumes significance. This concept seeks to address the mismatch between availability of RE sources and the requirement of the obligated entities to meet their renewable purchase obligation. (CERC 2010).

REC thus is a 'market-based instrument' which enables the 'obligated entities' inside the country to meet their renewable purchase obligation (RPO). The Electricity Act, 2003, mandates that all energy distribution licensee as well as consumers (generally industries) in India have to buy a minimum amount of renewable energy, as decided by the State Electricity Regulatory Commissions (SERC). According to the Central Electricity Regulatory Commission's 'Statement of Reasons' (SOR): 'the REC mechanism is aimed at addressing the mismatch between availability of RE resources in state and the requirement of the obligated entities to meet the renewable purchase obligation (RPO).'

For one MWh (megawatt hour) of electricity going into the grid from a renewable energy source, a RE generator is entitled to be issued a REC (by the CERC), which they can then sell to the obligated entities who need to meet their RPO under section 86 (1) (e) of the Electricity Act. Under the new RE trading scheme, 'Purchase of REC would be deemed as purchase of RE for RPO compliance,' as the SOR puts it.

So far, so good. Yet one fails to understand how exactly this 'market-based instrument' will facilitate RPO compliance. The SOR quoted above admits that despite the 2003 Act mandate, the obligated entities could not buy power from renewable sources, and actual generation in the RE sector has fallen far short of the installed capacity. Will the new RECs introduce new technologies (as CDM claims to do) that will radically increase actual power generation? Will the RE generators' earnings from RECs be sufficient to encourage them to increase the installed capacity of their plants? At present, increasing generation capacity in most of the existing renewable projects (wind, biomass, hydro, waste-to-energy, and even solar) in India is not possible without acquiring more land, which potentially leads to more social and economic discontent, and further is only possible at a great environmental cost. That apart, both the CERC and the Power Ministry are curiously silent about who actually buys the RECs, or how many of the total issued RECs so far have been brought by obligated entities as part of their RPO compliance.

REC Trading Picks Up

In just one year, REC trading in India has picked up manifold, moving beyond the initial tentativeness. According to data furnished by the online Renewable Energy Trading Certificate Registry (RETCR) set up under the CERC, there are already 1020 (as of 6 February 2012) registered RE generators in the market, and the numbers are swelling everyday (on 29 January, the figure was 999).¹⁴ Up to 31 January 2012, a total of 699,688 RECs have been issued, and nearly all of them have been redeemed (sold), while in November 2011, half of the RECs were lying unsold.

The RETCR site does not provide any data about prices. However, according to another source,¹⁵ the trading in renewable energy certificates touched a new height, both in volumes and in price in December 2011. In one month, as many as 111,621 RECs were traded on the two exchanges—Indian Energy Exchange (IEX) and Power Exchange of India Ltd (PXIL). Ninety-five percent of the trading took place in IEX. The average prices were ₹2950 a REC on both the exchanges, while in November, the average price was ₹2900 on the IEX and ₹2800 on PXIL. Volumes have been picking up as well: in September, 46,363 RECs were traded, which was more than twice as much as in the previous month. In October, the number rose to 95,504, and further to 105,000 in November. In January 2012 it went up to 171,524.¹⁶

RE trading is already being called the ‘new sunrise sector of India.’ According to an analysis, the existing RE projects can continue with their CDMs along with their RECs; there is no bar. CDM was earlier mentioned as ‘the icing on the cake’ by market analysts, and REC is going to be the icing on the icing, substantially increasing the profitability of the RE companies.¹⁷

But who are the buyers? Are the obligated entities defined by the SERCs going to the power exchanges and buying RECs to meet RPO targets? If there is purchasable power in the market, why are they unable to buy it directly from the grid, or, better, set up their own RE plants? Once again, the RETCR provides no data. From an unverified

source (Roy 2011), it was learnt that 400 Indian companies have registered with the RETCR as open access consumers (up to September 2011).

Regulation 5 of the CERC REC Regulations specifies eligibility criteria for an RE generator under the REC framework:

A generating company engaged in generation of electricity from renewable energy sources shall be eligible to apply for registration for issuance of and dealing in Certificates if it fulfils the following condition:

- a. It has obtained accreditation from the State Agency;
- b. It does not have any power purchase agreement for the capacity related to such generation to sell electricity at a preferential tariff determined by the Appropriate Commission; and
- c. It sells the electricity generated either
 - (i) to the distribution licensee of the area in which the eligible entity is located, at a price not exceeding the pooled cost of power purchase of such distribution licensee,or
 - (ii) to any other licensee or to an open access consumer at a mutually agreed price, or through power exchange at market determined price.

One can see that the 'selling' provisions are delightfully vague and inclusive, and definitely not limited to RPO compliance. An obligated entity can be a distribution licensee, or 'any other' licensee that has an RPO. But it can also be an 'open access consumer' who can go to an exchange and buy the RECs at a competitive price. Who are these 'open access consumers?' It was seen that brokers and financial speculators of all kinds had plagued the CDM market so far; it is they—and not the corporations and countries who have to prove Kyoto compliance—who buy the CERs in the climate exchanges and outside. Are these players present in the REC market as well? How much of the trade volume is going to the American voluntary offset markets, operating outside the European Kyoto markets?

While it is too early to get all the answers, one thing can safely be said. The RECs will provide yet another business opportunity to

the corporations and market players of all sorts currently involved in the carbon market; in fact, in comparison with CDM, RE trading is a veritable cakewalk. The project developers or RE generators do not need to demonstrate any emissions reduction in order to be eligible; nor do they have to pay often prohibitive transaction costs. No barriers apply, and hence no additionality. This leaves the generators legally free to access all sorts of subsidies permitted in the REC regime.

It can be further seen that the REC market grows at the same time that the CDM one slumps. The uncertainties about the second commitment period of Kyoto coupled with the continued economic recession in Europe has robbed the global carbon market of its sheen, while the relatively buoyant Indian economy provides a more efficient and secure financial cushioning to the emerging RE market. At a later date, India can even demand for international recognition of its RECs as part of its own compliance, if it agrees to a binding emission cut in the future.

4.5 Mitigating Climate Change through India's Forests: Green India Mission (GIM) and REDD+

Instead of real and verifiable measures that reduce emissions at source, India's mitigation package thus consists entirely of promotion of various forms of carbon markets, in the form of CDM, RE trading, and REDD+. The last is the newest form of carbon forestry, and has been making the rounds in the CoPs and other climate negotiations for the last few years.

Ever since the climate change discussions started, and especially after forests and the carbon they sequester turned into commodities in the global market following the Kyoto Protocol, the Indian government has been showcasing its forests as outstanding examples of mitigation. The latest such carbon sequestration claim was published in a 'technical paper' authored by the Indian Council of Forestry Research and Education, along with the Forest Survey of India and

Indian Council for Remote Sensing, for the Ministry of Environment and Forests (GoI 2009):

Carbon Storage and Sequestration Potential of India's Forests and Tree Cover

India's Forest Cover accounts for 20.6% of the total geographical area of the country as of 2005. In addition, Tree Cover accounts for 2.8% of India's geographical area. Over the last two decades, progressive national forestry legislations and policies in India aimed at conservation and sustainable management of forests have reversed deforestation and have transformed India's forests into a significant net sink of CO₂. From 1995 to 2005, the carbon stocks stored in our forests and trees have increased from 6245 million tonnes (mt) to 6662 mt, registering an annual increment of 38 mt of carbon or 138 mt of CO₂ equivalent.

Mitigation Service by India's Forest and Tree Cover

India's forests serve as a major sink of CO₂. *Our estimates show that the annual CO₂ removals by India's forest and tree cover is enough to neutralise 11.25% of India's total GHG emissions (CO₂ equivalent) at 1994 levels, the most recent year for which comparable data is available for developing countries based on their respective National Communications (NATCOMs) to the United Nations Framework Convention on Climate Change (UNFCCC). This is equivalent to offsetting 100% emissions from all energy in residential and transport sectors; or 40% of total emissions from the agriculture sector.* Clearly, India's forest and tree cover is serving as a major mode of carbon mitigation for India and the world.

The value of the stored/sequestered carbon is then calculated:

Putting a conservative value of US\$ 5 per tonne of CO₂ locked in our forests, this huge sink of about 24,000 mt of CO₂ is worth US\$ 120b, or Rs. 6,00,000 crores. Incremental carbon under scenario three will add a value of around US\$ 1.2b, or Rs. 6000 crores every year to India's treasury of forest sink, assuming a value of US\$ 7 per tonne.

It might be good to remember here that India has maintained, since very early days of the trade in forest carbon, that it can generate around 5 mtc (million tonnes of carbon)/year from so-called LULUCF projects—projects involving Land Use, Land Use Change

and Forestry: a CDM project category under which new sinks or carbon forests can be set up in lands which never had forest as a land use previously. This total is about 10 percent of the projected global total of 50 mtc from such projects (Planning Commission 2003). Translated into carbon credits at the rate of four dollars a tonne, this sequestered carbon would fetch a value of \$125 million over the five year period of 2008–2012 (*ibid*).

This focus on carbon sequestration by India's forests has consistently appeared in all the country submissions that India has sent during the course of the ongoing REDD negotiations. So too has the assurance that this amount of carbon sequestration will still be adequate to dent the country's emissions, even when these emissions will be on the increase because of an 'accelerated development process' (GoI 2009).

Of late, India has been pushing to replace the REDD scheme with REDD+. While REDD is a typical market mechanism which estimates a standing forest's carbon sequestration capacity and then provides a trading platform where this sequestered carbon can be sold, REDD+ is more holistic. According to the Government of India, it looks at the entire spectrum of services to be had from a forest, instead of only at carbon. A closer look, however, reveals that REDD+ is never too distant from the market: the MoEF's official papers dealing with forest policy and REDD+ make it clear that the Indian government always keeps an eye on the carbon market. Here we look at two of these papers.

GIM and REDD+: A Note titled India and REDD+ from the Ministry of Environment and Forests, 2010

The note informs us that the Indian government's interest in REDD+ is purely altruistic: it wants to 'pass on' the incentives received from REDD+ 'to the local communities in protection and management of the forests.' Immediately afterwards, the note claims 'that a REDD+ programme for India could provide capture of more than 1 billion tonnes of *additional* CO₂ over the next 3 decades and

provide more than USD 3 billion as *carbon service incentives* under REDD+(italics added). 'REDD+ will benefit local communities as it explicitly safeguards their rights and those of indigenous peoples. India is committed that monetary benefits from REDD+ will flow to local, forest dependent, forest dwelling and tribal communities,' it further claims.

Interestingly enough, the note then plunges into the Green India Mission, one of India's eight climate missions, and showcases it as a REDD+ and REDD-readiness exercise. This 'new flagship forestry programme' of India will generate five million hectares of new vegetation cover and resuscitate and conserve another five million hectares of forests with 'a budget of Rs. 46,000 crore (approx. USD 10 billion) over a period of 10 years,' and thus 'will help in improving ecosystem services in 10 million ha of land, and increase flow of forest-based livelihood services to, and income of about 3 million forest dependent households.' The note claims that the Mission marks a 'fundamental shift from our traditional focus of merely increasing the quantity of our forest cover, towards increasing its quality and improving provision of ecosystem goods and services' (emphasis added), by 'not merely focusing' on 'plantations to meet carbon sequestration targets.' The Mission is all about a 'deliberate and major focus on autonomy and decentralization' and will be 'implemented through an autonomous organizational structure with a view to reducing delays and rigidity, while ensuring accountability.' The 'local communities will be at the heart of implementation, with the Gram Sabha [village assembly] as the overarching institution overseeing Mission implementation at the village-level', backed up by 'a cadre of young "Community Foresters," most of whom will be from scheduled tribes and other forest dwelling communities, to facilitate planning, implementation and monitoring of Mission activities at local level.'

Besides taking up the Green India Mission, India has made a submission to the UNFCCC on 'REDD, Sustainable Management of Forest (SMF) and Afforestation and Reforestation (A&R)' in December 2008, a Technical Group ('to develop methodologies and procedures

to assess and monitor contribution of REDD+ actions') has been set up, a National REDD+ Coordinating Agency is being established, a National Forest Carbon Accounting Programme is being institutionalized, the eleventh Conference of Parties (CoP 11) of the Convention on Biological Diversity (CBD) is being hosted by India in 2012, and a study on the impact of climate change on India's forests assigned to the Indian Network for Climate Change Assessment (INCCA), has been released in November 2010. This study claims that there is likely to be an increase in Net Primary Productivity (NPP) in India's forests from 20–57 percent by 2030.

Analysis of a Country Submission by the Ministry of Environment and Forests, 2011

This submission lays down the outlines of the institutional framework for REDD+ in India, and assures the reader that such framework will have space for 'local communities.' India's national strategy for REDD+ 'aims at enhancing and improving the forest and tree cover of the country thereby enhancing the quantum of forest ecosystem services that *flow to the local communities*' (emphasis added), says the note, '...in the Indian context, carbon service from forest and plantations is one of the co-benefits and not the main or the sole benefit.' Immediately after this, though, carbon estimates come in to the picture: 'Initiatives like Green India Mission (GIM) and National Afforestation Programme (NAP)...will annually add 2 million tonnes of carbon incrementally, and post-2020, the forest and tree cover will be adding at least 20 million tonnes of carbon every year.' To ensure this huge amount of carbon sequestration, India will need an investment of 'Rs. 90 billion (USD 2 billion) every year for 10 years,' which will mainly come from 'financial support from UNFCCC.'

The submission then presents the institutional structure of REDD+: 'The Government of India has established a REDD+ Cell in the Ministry of Environment and Forests having the task of coordinating and guiding REDD+ related actions at the national level, and to discharge the role of guiding, and collaborating with the State

Forest Departments (SFDs) to collect, process and manage all relevant information and data relating to forest carbon accounting. *National REDD+ Cell would also guide formulation, development, funding, implementation, monitoring and evaluation of REDD+ activities in the states*’ (emphasis added). The wording makes it amply clear that the Ministry, and the forest bureaucracy under it, assume sole and complete responsibility for running the REDD+ show. In the following sections, the note talks about carbon accounting, which the Forest Survey of India (FSI) and the State-level (or in REDD terms, ‘sub-national’-level) forest departments will do together.¹⁸

The government is keen on ‘*ensuring the safeguards for the rights of the local communities including tribals, and above all of women folk of the local communities*,’ says the note, and it further ‘*intends to involve the civil society and state forest departments in working out provisions and modalities for the same under the extant Forest Rights Act, and approaches of Joint Forest Management (JFM) and Community Forest Management (CFM)*’ (emphasis added). Further on, the note lists the ‘safeguards’ the developing countries are expected to follow in order to ‘ensure full participation of indigenous peoples, local communities and other stakeholders,’ including steps to ‘ensure that all REDD+ incentives available from international sources flow fully and adequately to the local communities which participate in *management or manage the forest resources or are dependent on the forest resources for sustenance of their livelihood*’ (emphasis added). The note then claims that, ‘In India, tribals, forest dwellers and other local communities *have always enjoyed legal safeguards to practise their customary rights and traditions*’ (emphasis added). This last assertion is particularly ironic in light of the fact that colonial forestry practices started in India with the legal fiction of ‘extinguishing’ practically all community rights. In the history of Indian jurisprudence, there hasn’t been any ‘forest’ act since then that even remotely allowed ‘customary rights and traditions’ (until the Forest Rights Act of 2006, which has yet to be properly implemented).

The note goes on to cite the ‘success story’ of Joint Forest Management: ‘...initiative involving local communities for

protection and management of government forests. Joint Forest Management (JFM) ensures a fair share in the forest produce for the protecting communities. So far, more than 100,000 JFM committees covering about 22 million ha, which is about 30% of total forest area of the country, have been formed with about *22 million participating members* (emphasis added). The reality is that the forest movements and community groups in India never accepted JFM: they always viewed JFM and related data with distrust, for in practice this programme has never been genuinely participatory, and has merely been a way for the Forest Department to extend its activities. Further, JFM is not codified through legislation: rather, interpretation of it has always depended upon State forest departments, which invariably choose to enhance their own powers and benefits. The Forest Rights Act, the only true 'legal safeguard' for indigenous rights in India, is barely mentioned in the submission.

Summing Up the Indian Government's REDD+ Claims

Reading the above in conjunction with the Indian government's Green India Mission (GIM) statement and India's previous country submissions on REDD and REDD+, the following key claims emerge:

1. India has successfully measured the carbon stored in its forests, and also mapped the storage potential.
2. Its emphasis on REDD+ is driven by its desire to ensure the welfare of its forest-dependent communities.
3. It knows exactly how much financial incentive can be generated out of the carbon in India's forests, and consequently, can be passed on to the communities.
4. It not only has the necessary legislations in place to ensure that all existing community rights will be safeguarded under the REDD+ regime, but it also has a decentralized autonomous structure in place to ensure community involvement in REDD+ projects.

5. This structure is Joint Forest Management Committees (JFMC) under the Gram Sabha (the village assembly), to be overseen and monitored by District Level Committees consisting of and led by government representatives like the District Forest Officer, community representatives like the members of JFMC and other unnamed stakeholders.
6. This REDD+/GIM structure is in consonance with international REDD+ agreements and the commitment to upholding community rights expressed therein.

Questioning the Claims: Cooked up Carbon Storage Data?

Each of these conclusions is questionable. Despite the self-proclaimed community-centric nature of REDD+, communities living in Indian forests were neither consulted nor informed when the carbon sequestration potential (and hence, business potential) of their forests was being measured. Following an utterly non-transparent and undemocratic process limited to a handful of government officials and a few handpicked NGOs, the forests have been measured for their so-called 'carbon value.' The process has also ignored the key fact that even in the Indian national context, measurement of forest carbon has always been a disputed issue, and there is still no universally accepted and standardized model for such measurement (Ghosh et al. 2011). It has also been pointed out that such assessment wilfully underplays the importance of frequent and sometimes large deforestation events, due mostly to anthropogenic causes, and the forest cover data based on satellite imageries that the government agencies offer have always been suspect (*ibid*). The latest 2011 *State of Forests* report, published by the Forest Survey of India, shows that up to 30 percent deforestation had been recorded in certain central Indian districts, even though the net cover has gone up.

Questioning the Claims: Evident Emphasis on Carbon Forestry

Though the Indian government likes to emphasize the non-carbon values of forests in REDD+, it finally returns to estimates of carbon

credit sales when talking of specific incentives. One reason for this may lie in the relative non-tradability (for the time being, at least) of 'other' non-carbon environmental services provided by forests (for instance, hydrological services and biodiversity) (Pisupati 2011).¹⁹

Questioning the Claims: GIM and REDD+ as Attacks on Community Rights

As for the ostensibly enabling legislations and decentralized GIM, India's promotion of REDD+ and its Green India Mission have been sharply challenged by forest movements and community groups in the country; in fact, both GIM and REDD+ have been seen as attempts to sell off the country's forests in the international carbon markets.²⁰ These groups point out that the Indian government, particularly the Environment Ministry, has been consistently undermining and sabotaging the implementation of the historic Forest Rights Act ever since it was started. REDD+ and GIM will only accentuate the prevailing inequity and miscarriage of justice inherent in India's forest policy regime, the core of which consists of coercive colonial legislations like the Indian Forest Act, 1927 and the draconian Wild Life Protection Act, 1972.

Numerous other problems with the government's assertions on this point emerge from a close reading of the texts. One, though both the REDD and REDD+ concepts are as yet full of uncertainties and imprecision, the Government of India has started compliance exercises inside the country, without bothering to clear any of the innumerable apprehensions about the processes.

As of now, there are no safeguards for forest communities' rights in REDD+. On the contrary, there is every danger that all kinds of community access in forests will be badly restricted by a functional REDD+ project. News from all parts of the globe indicate that communities are being blackmailed, tortured and made subject to all sorts of exploitation in the name of REDD and/or carbon forestry, with both national governments and private companies involved in such activities.²¹ Despite the 'community-friendliness' expressed in

the MoEF REDD+ note, there is no guarantee that things will be different in India, given the ongoing near-feudal tyranny of the Forest Department in most of the country's forests and the increasing hold of corporate capital over forest areas.

The manner in which concepts of 'local communities' and 'rights' are dealt with in the REDD texts are dubious, to say the least. The MoEF equates 'communities' with JFM committees, which are nothing but extensions of the Forest Department and which have no actual powers. The question of 'rights' is problematic as the Indian government has no updated record of rights insofar as forest communities are concerned, and it continues to ignore its own legislation (the FRA), which recognizes a range of community and individual rights—including, providing for completely community-managed forests in all types of forests. The government prefers to focus on creating rights-free 'protected areas' for wild life conservation while also diverting forest land for development projects like mining, large dams and power plants. Indeed, one of the main reasons why the carbon sequestration estimates offered by the Government of India do not stand scrutiny is that the rate of deforestation for industrial/commercial purposes in India is rising alarmingly, and the carbon markets completely sidestep this fact. One recent estimate²² shows that in last 30 years (1981–2011), 1,198,676 hectares of forests have been diverted for non-forest use. In the past four years, 204,425 hectares of forests were converted, mostly to mines and various industrial projects.

It becomes obvious that instead of a community-centric approach and philanthropy, money, and particularly money from carbon trading, is the core of the Indian government's approach to REDD+. Some of that money may trickle down to forest communities in some cases once the REDD+ (and GIM) gets going, but the fund-flow will definitely not be controlled by these communities. Such trickling down too will essentially be driven by the desire of the government to keep the forest-dependent poor away from forests, as has been the government's agenda for decades. Given the experiences of JFM in India, the money will come in form of

so-called ‘support activities,’ for instance, manufacture and/or supply of low-smoke or woodless stoves.

Questioning the Claims: No Transparency in REDD+

Another important question remains unanswered. What information about REDD+ will be given to forest dependent communities? Will forest dwelling communities, already severely affected by changing monsoon cycles and other climate change impacts, come to learn that their forests are being traded in international markets so that polluting companies in the rich countries can continue with their business-as-usual emissions? With its apparent emphasis on non-carbon forest services and talk of multiple objectives, the government may try to create an illusion that REDD+ is anything but carbon trading. Will the communities affected by these projects be given an informed choice about rejecting or accepting the project?

In most parts of India, where the government continues to exercise management control over all forms of forests, the answer is clearly ‘no.’ As has occurred in previous and ongoing externally aided forestry programmes, government officials will control the GIM and any other REDD+ type programme in its entirety, and the only permitted community presence will be through JFM. In some other parts of the country, particularly the northeast, where there are still customarily held community forest areas, this is a more open question.

4.6 Meaningful Mitigation Action: What Needs to be Done

Moving away from the government recipe of carbon markets and similar market-linked solutions is the first sensible action that the country needs to take. Experiences from all over the globe, including India’s own, prove conclusively that such solutions do not offer mitigation; rather they exacerbate the existing crisis, and make the majority of the population even more socially, ecologically and economically vulnerable.

The second action should be to establish transparency: affected people from all sections of the society, but especially the poor and the marginalized, must be first informed of the danger they face from rising seas, floods, failed monsoons and so on. The mitigation actions must be taken in consultation with the people of the country, not by keeping them permanently in the dark and forcing their consent by means of either coercion or so-called monetary incentives. For instance, forest communities must be given free choice to govern their forests in accordance with the country's laws, and their constitutional rights over forests must not be compromised in order to implement dubious market-driven climate solutions like REDD or REDD+.

The third action should be to list specific actions that the country must take to reduce its growing carbon footprint. Such actions must be transparent, tangible and independently verifiable. For instance, if an industry claims to be energy efficient or is obliged, under any law, to increase energy-efficiency, it has to prove compliance. Chronically polluting industries or industrial projects with observed and/or potential socio-environmental impacts can no longer be allowed to continue with expanding their current production limits simply on the basis of the self-professed, or, alternatively, 'certified' (by consultancy firms paid to do so) cleanliness of their actions.

The same holds true about renewable energy and other non-thermal energy sources such as big hydropower and nuclear. The mere fact that a form of generation has a renewable tag or is non-thermal in nature should not be taken as implying mitigation by default. For instance, large wind energy projects and hydropower projects that hit local communities' ecology and economy cannot be treated as mitigation.

Finally, and most importantly, the growth agenda of the country must be re-drawn in favour of the people who need it most and who lose most from both climate change and its solutions. The energy requirements of the country should be freshly and transparently assessed, and a truly energy-efficient, equitable and decentralized power generation mechanism should be put in place.

We need these mitigation actions here in India for our own sake. The next and the concluding chapter of this study discuss this in detail.

Notes

1. For instance, MoEF and TERI, (2005), IGES, Winrock International and Ministry of Environment, Japan, (2005), and Planning Commission (2003): all of which reflect the initial euphoria about CDM. There have since been numerous papers on the subject, and there are several websites dedicated to Indian CDM.
2. All data on CDM projects, unless otherwise specified, were taken from www.cdmpipeline.org, which forms the main source of CDM data and is constantly updated. See www.cdmindia.nic.in, a site by the Environment Ministry for State and sector-wise information on Indian projects; this site however is not very organized. Also see www.unfccc.int.
3. See http://www.cdmindia.gov.in/approval_process.php for more details.
4. See <http://www.dailymail.co.uk/home/moslive/article-1188937/The-great-carbon-credit-eco-companies-causing-pollution.html> for more details. See also Böhm and Dabhi (2010).
5. See http://indiaearnings.moneycontrol.com/sub_india/corpannoun.php?sel_comp=JVS and <http://www.capitalmarket.com/Ccredit/story2-0.asp?SNo=152283>, as well as <http://news.moneycontrol.com/india/news/stockmarket/marketnews/20/47/19>.
6. See <http://indscanblog.com/2010/03/16/jsw-steel-gets-carbon-credits-alloted> for more details.
7. See www.carboniyatra.com for more details.
8. *Times of India*, 10 August 2006; available at http://findarticles.com/p/news-articles/times-of-india-the/mi_8012/is_20060810/gujarat-fluro-sets-record-carbon/ai_n39426560/. See also <http://indiaearnings.moneycontrol.com> for more information.
9. See http://www.carboniyatra.com/news_detail.php?id=851 for more information, as well as http://www.moneycontrol.com/news/buzzing-stocks/guj-fluorochem-gets-carbon-credits-worth-rs-158-cr-stk-up_391942.html. The trend continues and GFL stocks immediately rose in August 2011, when a fresh round of issuance took place. See <http://www.indiaonline.com/Markets/News/Gujarat-Fluorochemicals-recovers-on-buzz-on-winning-carbon-credits/3898827856>.
10. See <http://www.thehindubusinessline.com/companies/article2221916.ece> for more details.
11. Tangri and Shah (2011), Third World Network. See www.twinside.org.sg for more information. See also S. Dev in *Mausam* 2-5.

12. See *Mausam*. See also *Request for Review of the Additionality of CDM Project 4533: Greenhouse Gas Emission Reductions through Super Critical Technology—Coastal Andhra Power Ltd., India*, a letter from the Sierra Club and CDM WATCH to the CDM Executive Board, UNFCCC, challenging the CDM status of the Reliance Clean Coal project, June 2011.
13. See <http://www.climate-consulting.org/2011/09/09/wikileaks-and-the-cdm/> for more details, as well as <http://www.internationalrivers.org/en/node/6855>.
14. See <https://www.recregistryindia.in>.
15. See <http://www.thehindubusinessline.com/industry-and-economy/article/2755229.ece> for more. See also Roy (2011).
16. See <https://www.recregistryindia.in>.
17. See <http://www.commodityonline.com/news/iex-starts-trading-of-renewable-energy-certificate-36700-3-1.html>, and <http://www.bloomberg.com/news/2011-01-28/cash-for-clean-energy-trading-to-start-in-india-with-threat-to-un-market.html>. See also *Renewable Projects in India: What to Adopt-CDM or REC?*, Agneya, for a typical market analyst's take on the benefits of both CDM and REC: <http://agneyablog.wordpress.com/2011/02/14/renewable-projects-in-india-what-to-adopt-cdm-or-rec/>.
18. FSI's *State of Forest Report*, 2011. The Report contains a whole chapter on the 'sink' potential of Indian forests, evidently as a REDD+ exercise.
19. There is a fair chance that a market-linked package on ecosystem services trade may finally appear in the forthcoming CBD CoP in India.
20. See NFFPFW and CSD (2009, 2010); also Jha (2011) and Aggarwal (2011) for more information on REDD in India.
21. REDD and other variants of carbon forestry like smaller 'offset' plantation projects and larger CDM plantation projects. For a compilation on REDD-related case studies see *No REDD, A Reader*, Carbon Trade Watch and Indigenous Environmental Network, 2011, <http://noredd.makenoise.org/>. See also the *REDD Monitor*, www.redd-monitor.org, for more news and critique of REDD. For market logic and information related to REDD and other carbon forestry projects see <http://www.ecosystemmarketplace.com>.
22. See <http://www.downtoearth.org.in/content/environment-ministry-creates-record-forestland-diversion> for more information.

References

- Aggarwal, A. 2011. *Implementation of Forest Rights Act, Changing Forest Landscape and 'Politics of REDD+' in India*. unpublished paper.
- Böhm, S. and S. Dabhi (eds.). 2010. *Upsetting the Offset: The Political Economy of Carbon Markets*. UK: MayFly Books. Also available at <http://mayflybooks.org/wp-content/uploads/2010/07/9781906948078UpsettingtheOffset.pdf>.

- Carbon Trade Watch (CTW) and Indigenous Environmental Network (IES) et al. 2011. *No REDD, A Reader*. Hallie Boas (ed.). Oregon USA: Charles Overbeck/Eberhardt Press. Available at <http://noredd.makenoise.org/>.
- UNEP (United Nations Energy Programme) CDM Database available at www.cdmpipeline.org.
- Central Electricity Regulation Commission (CERC). 2010. 'CERC (Terms and Conditions for Recognition and Issuance of Renewable Energy Certificate for Renewable Energy Generation) Regulations, 2010: Statement of Objects and Reasons.' Available at <http://nldc.in/REC.aspx> and also <http://cercind.gov.in>.
- D'Monte, Leslie. 2009. 'Carbon credits offer us a Rs 28,000-cr opportunity,' *Business Standard*, 11 December. <http://www.business-standard.com/india/news/carbon-credits-offer-usrs-28000-cr-opportunity/379231/>.
- Forest Survey of India (FSI). 2011. *India State of Forest Report 2011*. Dehradun: Forest Survey of India, Ministry of Environment & Forests.
- Ghosh, Soumitra, Hadida Yasmin, Arindam Das. 2011. 'Imaginary Sinks: India's Forest Carbon Ambitions,' in NFFPFW, NESPON and DISHA. 2011. *The Indian CDM: Subsidizing and Legitimizing Corporate Pollution*. Kolkata: Dishsa.
- GoI. 2008. *National Action Plan on Climate Change (NAPCC)*. Delhi: Prime Minister's Council on Climate Change, Government of India. Available at <http://pmindia.nic.in/Climate%20Change.doc>.
- . 2009. *India's Forest and Tree Cover: Contribution as a Carbon Sink*, Ministry of Environment and Forests. August.
- Hannon, E. 2009. 'An Indian Village Sees the Downside of Carbon Trading,' *Time*. Available at <http://www.time.com/time/health/article/0,8599,1945243,00.html>.
- IGES, Winrock International and Ministry of Environment, Japan. 2005. *CDM Country Guide for India*. Japan: Sato Printing Co. Ltd.
- Jha, S. 2011. *The Green India Mission (GIM): A Roadmap for Neo-liberal Exploitation in Forest*, Unpublished paper.
- Juneja, S. 2011. 'Sponge iron's dirty growth,' *Down to Earth*, 31 January. Available at <http://www.downtoearth.org.in/content/sponge-iron-s-dirty-growth>.
- Lahiri, S. 2008. 'India's bio-fuel expansion—The Chattisgarh Story,' *Mausam*, 1.
- Lohmann, L. 2006. 'Carbon Trading, a Critical Conversation on Climate Change, Privatisation and Power,' *Development Dialogue*, 48. Sweden.
- Mausam*. Various issues available at www.thecornerhouse.org.uk/resource/mausam, www.thecornerhouse.org.uk/resource/mausam-issues-2-5, www.thecornerhouse.org.uk/resource/mausam-0.
- Michaelwoa, A. 2006. 'Additionality Determination of Indian CDM Projects: Can Indian CDM Project Developers Outwit the CDM Executive Board?' unpublished manuscript.
- MoEF and TERI. 2005. *CDM Implementation in India—The National Strategy Study*. Delhi: TERI Press, The Energy and Resources Institute.

- NFFPFW and CSD. 2009. *On REDD Climate Scheme—Joint Statement by Indian forest movements*. Available at www.forestrightsact.com/climate-change/item/download/33.
- . 2010. *A Formula for More Land and Resource Grabbing: Dangers of the Green India Mission—Joint Statement by Forest Movements in India*. Available at <http://forestrightsact.com/statements-and-news/90-dangers-of-the-green-india-mission>.
- NFFPFW, NESPON and DISHA. 2011. *The Indian CDM: Subsidizing and Legitimizing Corporate Pollution*. Edited by S. Ghosh and S.K. Sahu. Kolkata: Disha. Available at <http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/The%20Indian%20CDM.pdf>.
- Pisupati, B. 2011. *Convergence of Ecological and Economic Indicators and Valuation*, National Biodiversity Authority.
- Planning Commission. 2003. *Report of the Working Group on National Action Plan for Operationalising CDM in India*. Delhi: Public Printing (Delhi) Service.
- . 2006. *Integrated Energy Policy, Report of the Expert Group*. Delhi: Government of India.
- Roy, Vijay C. 2011. '400 Companies Register for Renewable Energy Certificate,' *Business Standard*, New Delhi, 5 October. Available at <http://www.business-standard.com/india/news/400-companies-register-for-renewable-energy-certificate-/451572/>.
- Tangri, N. and D. Shah. 2011. 'CDM Misadventures In Waste Management,' *TWN Info Service on Climate Change (Jun11/02)*, 9 June, Third World Network. Available at www.twinside.org.sg.
- The Sunday Times*, 22 April 2007: available at <http://www.timesonline.co.uk/tol/news/uk/article1687531.ece>.
- United Nations. 1998. Text of Kyoto Protocol to the United Nations Framework Convention on Climate Change. http://unfccc.int/essential_background/kyoto_protocol/items/1678.php.

5

Adaptation to Climate Change in India A Bleak Future

Soumya Dutta

5.1 Introduction

As impacts of climate change increasingly affect people in poorer countries, the international community, country governments and institutions will need to devise and implement strategies and work programmes to reduce/minimize these adverse impacts, and to ensure that the affected people can cope with the dangers. The UNFCCC and the Kyoto Protocol recognized this, and also mapped out a loose and broad framework of needs and commitments (though highly inadequate) to tackle climate change. The Kyoto Protocol was explicit in this regard: adaptation needs of affected communities would have to be backed up by adequate financing, it said, and the many new climate adaptation challenges would also require unhindered technology transfer to less developed countries so that people's lives and livelihoods are not terminally affected. This is the basic conceptual understanding behind adapting to climate change.

Adaptation cannot be totally isolated from mitigation, or reduction of the root cause, and the original text of the Kyoto Protocol mentions this clearly:

All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances ...shall:

Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change:

- (i) Such programmes would, inter alia, concern the energy, transport and industry sectors as well as agriculture, forestry and waste management. Furthermore, adaptation technologies and methods for improving spatial planning would improve adaptation to climate change. (UN 1998: Article 10 para b sub para i)

For instance, evolving methods to replace flood irrigation for paddy, without reducing productivity or increasing input costs will reduce methane emissions from agricultural fields—a mitigation measure, though these are not a large part of emissions—while also serving as a good adaptation practice, as this helps small farmers to cope with the climate change-driven uncertainties of monsoon rainfall. Similar inter-connections exist in many other positive mitigation actions.

Adaptation Support: The Kyoto Protocol

Adaptation to climate change is the ‘adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates the harm or exploits beneficial opportunities’ (IPCC 2001). Doing these ‘adjustments,’ and on a large enough scale to be meaningful to the world’s vulnerable people, needs multi-dimensional support. The onus of organizing finance and making suitable technology available for adaptation was on the developed countries, as they were supposed to:

Cooperate in the promotion of effective modalities for the development, application and diffusion of, and take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies, know-how, practices and processes

pertinent to climate change, in particular to developing countries. (UN 1998: Article 10 para c)

The question of adequate finance being provided by the developed to developing countries was also specified clearly in Article 11, paragraphs (a) and (b):

- (a) Provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in advancing the implementation of existing commitments ... and
- (b) 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 advancing the implementation of existing commitments under Article 4, paragraph 1, of the Convention that are covered by Article 10 and that are agreed between a developing country Party and the international entity or entities referred to in Article 11 of the Convention, in accordance with that Article.

Thus, the issues of *mitigation, adaptation, financing and technology transfer* are intimately inter-linked; indeed, these are known as the *four pillars of the Kyoto Protocol*. Adaptation is necessary as mitigation would now be insufficient to halt climate change. However, if mitigation efforts keep lagging as far behind as they are now—with no country reducing its emissions—the climate system will become so destructive that no amount of adaptation might save the vulnerable communities. Irrespective of many valid critiques of the Kyoto Protocol, it does have this limited value: the more ‘capable’ countries were to take actions that ‘facilitate the development and deployment of techniques that can help increase resilience to the impacts of climate change,’ which is one component of adaptation.

Bali Action Plan 2007

It was only after the release of the IPCC-AR4 in February 2007 that the issue of adaptation became prominent. The 13th Conference of Parties in Bali, Indonesia, held in 2007, was the first CoP after this

release (UNFCCC 2008). The following was proposed as part of the ‘Bali Action Plan’:

Enhanced action on adaptation, including, inter alia, consideration of:

- (i) International cooperation to support urgent implementation of adaptation actions, including through vulnerability assessments, prioritization of actions, financial needs assessments, capacity-building and response strategies, integration of adaptation actions into sectoral and national planning, specific projects and programmes, means to incentivize the implementation of adaptation actions, and other ways to enable climate-resilient development and reduce vulnerability of all Parties, taking into account the urgent and immediate needs of developing countries that are particularly vulnerable to the adverse effects of climate change, especially the least developed countries and small island developing States, and further taking into account the needs of countries in Africa affected by drought, desertification and floods;
- (ii) Risk management and risk reduction strategies, including risk sharing and transfer mechanisms such as insurance;
- (iii) Disaster reduction strategies and means to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change;
- (iv) Economic diversification to build resilience;
- (v) Ways to strengthen the catalytic role of the Convention in encouraging multilateral bodies, the public and private sectors and civil society, building on synergies among activities and processes, as a means to support adaptation in a coherent and integrated manner.

Various Facets of Adaptation

As partly illustrated above, there are many sectors and geographical areas hit by climate change. Adaptation, therefore, requires a variety of policies and plans to provide adequate support to affected communities—both on the part of national governments and with regard to concerned international mechanisms. The number of people being affected is also very large. According to one estimate, ‘in 2008

alone, more than 20 million people were displaced by sudden climate-related disasters... An estimated 200 million people could be displaced as a result of climate impacts by 2050; climate change currently contributes to the global burden of disease and premature deaths... adverse health impacts will be greatest in low-income countries, including from heat stroke, malaria, dengue and diarrhoea' (UNFCCC 2010). Increased flooding, droughts, desertification, coastal inundation and salinization of ground and surface water, loss in agricultural productivity, extreme climate events like intense storms, spread of geographically uncommon diseases and accelerated loss of biodiversity are some of the most critical adverse impacts of climate change, and the world needs adaptation measures on an urgent basis in all of these areas. One of the broad strategies suggested in this regard is to 'mainstream' adaptation, rather than looking at adaptation as an additional component in mainstream plans. Evolving national action plans on climate change would constitute one such 'mainstreaming' approach, if done in the right way. However, groups working on adaptation, such as Tearfund (Wiggins 2011), suggest placing climate plans at the centre of national development planning (an approach known as integration). Based on their field research in Bangladesh and Nepal (two of the most vulnerable countries), Tearfund recommends that:

Developing country governments, with the support of multiple agents... need to:

1. Provide senior political leadership with the authority to drive inclusive activity...
2. Undertake consultative & participatory evidence gathering...
3. Improve communication around the science of climate variability...
4. Develop robust, inclusive, country-strategic adaptation action plans.....
5. Align national development plans with the country-owned adaptation strategy...
6. Establish a dedicated adaptation fund, which is additional...
7. Build the capacity of local governments and civil society.

These broad actions overlap with what developed country organizations prescribe, such as timely and local climate information systems, evolution of local and regional risk management strategies, mainstreaming of adaptation into national and regional plans, exploitation of synergies in mitigation and adaptation so that finance and other support mobilization becomes easier, with a focus on critically important country priorities as well as on participatory monitoring and evaluation of these plans and actions. All groups agree on the importance of local knowledge in coping with climate change impacts. According to the UNFCCC:

Community-based adaptation can greatly benefit from knowledge of local coping strategies. The secretariat has developed a local coping strategies database to facilitate the transfer of long-standing coping strategies and knowledge from communities which have adapted to specific hazards or climatic conditions, to communities which may just be starting to experience such conditions as a result of climate change.¹

What the Vulnerable Country Governments Are Doing

As discussed above, there are various adaptation measures that many poor country governments have either proposed or undertaken. These should be understood before turning to India.

Some countries have decided to join large-scale international efforts, such as the ‘Great Green Wall’ in Africa, being developed collectively by the African Union (with 11 countries participating). The ‘Wall’ is being planted south of the Sahara desert, with the aim of slowing down desertification and boosting farmer’s incomes. These nations plan to create a living wall of native trees 15 kilometres wide and nearly 7775 kilometres long, from Senegal to Djibouti across the African Sahel.² This plan is also known as the ‘Sahel Solution.’ As one commentator notes, ‘mixing trees and crops—a practice they have named “farmer-managed natural regeneration,” or FMNR, and that is known generally as agro-forestry—brings a range of benefits. The trees’ shade and bulk offer crops relief from the overwhelming heat and gusting winds. In the past, farmers sometimes had to sow their

fields three, four, or five times because wind-blown sand would cover or destroy seedlings... with trees to buffer the wind and anchor the soil, farmers need sow only once' (*Scientific American*, 28 January 2011). One factor that has contributed to the apparent success of the effort is the recognition/restoration of farmers' rights over the trees, in stark contrast to many other conservation measures where communities are excluded in the name of 'saving trees.' As another commentator notes, 'Planting trees is much too expensive and risky for poor farmers. Studies in the western Sahel have found that 80 percent of planted trees die within a year or two. By contrast, trees that sprout naturally are native species and more resilient. And, of course, such trees cost the farmers nothing. Even naturally sprouting trees were off-limits to farmers until laws were changed to recognize their property rights.'

Whereas it is a little early to assess results of such large-scale projects, there are other, smaller adaptation projects underway in many vulnerable countries. Such projects include:

- 'community-based watershed management' in Afghanistan,
- 'creating an early warning system for flooding and storms' and 'locally available adapted seed varieties' in Angola,
- 'promoting adaptation to coastal crop agriculture to combat increased salinity,' 'construction of flood shelters, and an information and assistance centre to cope with enhanced recurrent floods in major floodplains' and 'inclusion of climate change issues in curriculum at secondary and tertiary educational institution' in Bangladesh,
- 'protection of children under five and pregnant women against malaria in the areas most vulnerable to climate change' and 'adaptation of households to climate change through awareness-raising and capacity building on the use of renewable energy (solar energy) and energy-efficient stoves in the areas vulnerable to climate change and with highly degraded soils' in Benin,

- ‘GLOF (Glacial Lake Outburst Flood) hazard zoning’ in Bhutan,
- ‘rehabilitation of Upper Mekong and provincial waterways’ and ‘promotion of household integrated farming’ in Cambodia,
- ‘promoting urban and suburban forests’ and ‘promotion of the carbonization of wood byproducts from forest companies’ in the Central African Republic.

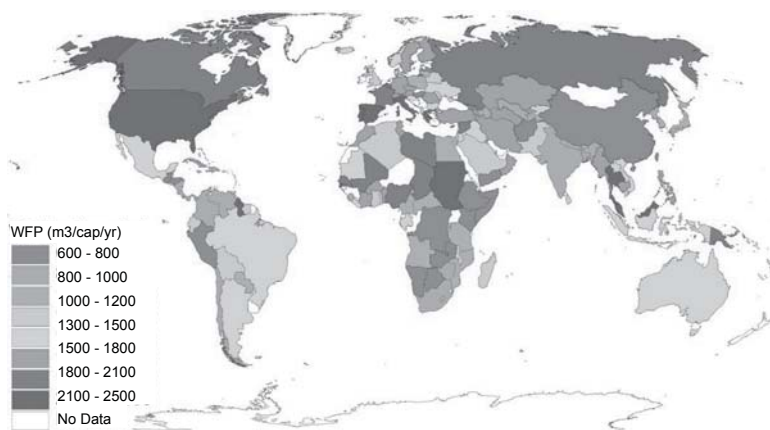
What emerges from this and similar lists is a tremendous level of confusion regarding what approach is to be adopted. Some countries take exclusionary positions, while others aim to be inclusive. Some focus on capital-intensive projects and others do not. There is no clarity on what adaptation actually requires.

5.2. Adaptation in India

We see the same hopelessly confused policy muddle in India. Thus, the national water mission in the National Action Plan for Climate Change (GoI 2008) promotes more big dams in the Himalayas, ostensibly for ‘expeditious implementation of water resources projects particularly the multipurpose projects with carry over storages.’ Similar confusion is visible in the push for techno-centric GM seeds and plants for adapting to changed temperature and humidity regimes, as well as in the attempts to exclude people from forests under the Green India Mission. The adaptation programmes being officially promoted exacerbate and intensify the threat against vulnerable communities instead of addressing it. The few decentralized, community centric initiatives for adaptation, such as using the Employment Guarantee Act to augment local water harvesting structures or promoting of less water-intensive rice cultivation, are too sporadic and few for a large country like India. The priority for the government continues to be large capital-intensive (and often very destructive) projects—such as the proposed Renuka Dam in Sirmour district of Himachal Pradesh, for securing Delhi’s water demand. Such projects are obvious indicators of the stranglehold the profit-centred business and industry have on our ‘policymakers.’

Another vital aspect of adaptation, namely reliable, locale-specific, short-to-medium duration information about unusual climatic changes or extreme events, is so rare that the vast majority of the population has no access to it. In this connection, the 2009 climate/monsoon prediction fiasco is an illustrative example of the callous indifference shown by the state towards the climate vulnerability of the vast majority of its people. In its first stage forecast of 17 April 2009, the Indian Meteorological Department said that 'the rainfall for the country as a whole is likely to be near normal. Quantitatively, monsoon season rainfall is likely to be 96% of the long period average with a model error of $\pm 5\%$. The long period average rainfall over the country as a whole for the period 1941–1990 is 89 cm.' The second stage forecast issued on 24 June (when the sowing season had begun in the south and east) was almost equally misleading: 'rainfall is likely to be below normal. Quantitatively, monsoon season rainfall for the country as a whole is likely to be 93% of the long period average with a model error of $\pm 4\%$.' By this time, clear indications were available that IMD is aware of the developing strong El Nino conditions, as evidenced by their internal reporting. Other reports—such as those of the U.S. Department of Agriculture (USDA 2009)—repeatedly warned that the 'window' of kharif paddy sowing, as well as that for corn, sorghum, millet and so on, would soon end. NASA images were available even to the lay public, indicating that an El Nino situation was developing along with unfavourable conditions in the Indian Ocean.

Despite this, the IMD did not think it fit to warn farmers. A large shortfall in monsoon rain in fact occurred that year. Drought conditions prevailed in most parts of the country. As a result, huge numbers of poor and marginal farmers lost not only their crops, but also the money they had taken on loan for inputs like seeds and fertilizers, while big farmers with resources and access to ground water were able to save part of their produce. With climate change impacts intensifying, erratic rainfall and other stresses will increase, and with information sharing with communities on the ground almost non-existent, the destruction is only likely to increase (Dutta 2009).

FIGURE 5.1: National Water Footprints

Note: Average national water footprint per capita (m³/capita/yr). Green means that the nation's water footprint is equal to or smaller than global average. Countries with red have a water footprint beyond the global average.

Source: UN World Water Development Report 2006.

Indeed, water is likely to be a major issue in adaptation. The amount of water countries use is shown in Figure 5.1 (UNESCO 2006). At 800–1000 cubic metre per person per year, India is just at the boundary of being water stressed, and climate change—along with our skewed water use policies—may change this for the worse. The coming years will see more misery unless adaptation measures tackle the critical issue of water for agriculture and drinking.

5.3 Climate Finance for Adaptation

Looking at the multi-dimensional challenges of climate change adaptation, the need for adequate finance becomes clear. The contours of the international climate finance system, which is meant to be supportive of both climate change mitigation and adaptation, emerged through a somewhat 'coloured' and unequal process of negotiations. The finance is also supposed to help developing countries move towards a less carbon-intensive 'development' path to fulfil the

TABLE 5.1: Recent Estimates of International Climate Finance Needed

Source	Year	Mitigation	Adaptation
EC (2009)	2020	94	10–24
African Group (2009)	2020	200	>67
World Bank (2009)	2030	139–175	20–100
UNFCCC (2008)	2030	>65	28–59

infrastructure and basic services needs of their citizens. These countries, particularly the least developed ones (LDCs), were to launch their own national adaptation programmes of action (NAPAs), and these were to be supported by finance, technology and capacity building by the industrial nations. The Nairobi Work Programme (NWP) on adaptation focused on ‘impacts, vulnerability and adaptation to climate change, development and transfer of technologies, research and systematic observation,’ thus also stating that finance was required for all of these tasks. In reality, very little of this finance has materialized. According to a report by the International Institute for Environment and Development, ‘while the need for climate finance in developing countries is disputed, it is estimated to amount to US\$100–250 billion a year by 2030.’³

In contrast, the existing climate finance institutions/mechanisms provide a minuscule amount, that too often for questionable projects. The existing mechanisms are:

1. Global Environment Facility under the UNFCCC, established in 1994;
2. Montreal Protocol Fund to eliminate ODS (ozone depleting substances, such as chlorofluorocarbons), set up in 1990;
3. Adaptation Fund, financed by a 2 percent levy on Clean Development Mechanism transactions, established in 2008 under the Kyoto Protocol;
4. Forest Carbon Partnership Facility, established by the World Bank in 2007;

5. Climate Investment Funds, established in 2008, and consisting of
 - a. Clean Technology Fund;
 - b. Pilot programme on Climate Resilience; and
 - c. Forest Investment Programme.

There are a few country specific funds for Bangladesh, Brazil and Indonesia. In spite of these, the total finance for world-wide climate change mitigation and adaptation is struggling to reach even the meagre figure of \$10 billion per year; this was the amount promised by the developed countries for the period 2010–2012 under ‘Fast Start’ financing. A May 2010 briefing paper from the World Bank states that ‘Low-carbon investment in developing countries consistent with a +2°Celsius climate stabilization target could cost \$139–175 billion a year by 2030. In addition, some \$75–100 billion could be required annually over the next 40 years to support adaptation to the inevitable impacts of climate change on developing countries, while the resources that have been committed so far to address mitigation and adaptation in these countries cover just 5 percent of the needs.’ The \$100 billion a year Green Climate Fund (itself far less than what is required), which was supposed to be functional from 2020, is yet to be launched. Another key shortcoming is that only about 3 percent of the total climate finance available goes into adaptation, though over 250 million people are in urgent need for help. The adaptation picture is bleak.

Notes

1. See <http://unfccc.int/adaptation> for more information.
2. ‘Great Green Wall’, Wikipedia, http://en.wikipedia.org/wiki/Great_Green_Wall.
3. See www.iied.org for more information.

References

- Dutta, Soumya. 2009. ‘Did the Meteorological Department Mislead the Nation on Monsoon 2009?’ *Mausam*, 1–2(2–5): 5–8. (available at <http://www>.

- carbontradewatch.org/archive/mausam-issues-2-5-talking-climate-in-public-space.html).
- GoI. 2008. 'National Water Mission (NWM),' *National Action Plan on Climate Change (NAPCC)*. Delhi: Prime Minister's Council on Climate Change, Government of India. Available at <http://pmindia.nic.in/Climate%20Change.doc>.
- IPCC. 2001. *Climate Change 2001: Third Assessment Report*. Cambridge: Cambridge University Press.
- UN. 1998. Kyoto Protocol to the United Nations Framework Convention on Climate Change, Article 10 para b sub para i., <http://unfccc.int/resource/docs/convkp/kpeng.pdf>.
- UNESCO. 2006. *World Water Development Report 2006*. Paris and New York: United Nations Educational, Scientific and Cultural Organization (UNESCO) and Berghahn Books.
- UNFCCC. 2008. 'Report of the Conference of the Parties to the UNFCCC in its thirteenth session, held in Bali from 3 to 15 December 2007.' <http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf>.
- . 2010. 'Fact Sheet : The Need for Adaptation,' October.
- USDA. 2009. *Global Agricultural Information Network (GAIN) Report no. IN9086*. U.S. Department of Agriculture.
- Wiggins, Sarah. 2011. *Adaptation United: Building Blocks from Developing Countries on Integrated Adaptation*. Teddington: Tearfund. http://tilz.tearfund.org/webdocs/Tilz/Research/Adaptation_United_web.pdf.

6

Conclusions

C.R. Bijoy, Hadida Yasmin, Shankar Gopalakrishnan,
Soumitra Ghosh and Soumya Dutta

Most discussions of climate change in India have so far focused either on the direct physical impacts of climate change or, even more narrowly, on the international talks. Yet, as discussed, climate change does not take place in vacuum. It occurs side by side with other processes—notably economic ones—that shape its impacts and that are, in turn, shaped by them. The final impact on people is determined by all of these processes acting together. The question is whether the policies currently being followed by the Indian state, and consequent economic processes at various levels, help to reduce the potentially devastating impacts that climate change can inflict on the country.

As the previous chapters reveal, the answer to this question currently is ‘no.’ In fact, these policies will inflict great harm on the environment and affect livelihoods dependent on the environment. This ultimately leads to the already beleaguered people of this country being further exposed to imminent natural disasters, all happening in the name of ‘development,’ which does not even remotely heed the needs of the majority.

6.1 Conclusions of the Present Report

In detail, the conclusions of this report are as follows:

1. *Physical impacts of climate change likely to be widespread and highly destructive:* The physical impacts of climate change in India are likely to be extremely large and destructive. One estimate is that two-thirds of the population will be affected. Moreover, the impacts are likely to be differentiated by area, community and social class. The analysis in this study shows that the oppressed and poor majority—such as those dependent on rainfed agriculture, those making a livelihood from fishing, those without access to adequate healthcare and so on—are likely to see their livelihood crises deepen. Further, an increase in natural disasters as well as changes in the hydrological cycle will most likely result in millions of people losing their homes and livelihoods. The policies that the government have put in place to respond to climate change, however, rarely even acknowledge these realities, leave alone attempt to tackle them.
2. *International talks process is failing; India's stand is apparently correct as a general principle, but weak, self-defeating and incomplete in practice:* The international talks process has comprehensively failed to respond to the needs of countries like India. The industrial countries have sought to defend their resource-grabbing and hence highly destructive neo-colonial economies. Meanwhile the Indian government has been content with taking an apparently correct, and purely defensive, stand on the right to equity in carbon emissions. No coordinated internal effort has been made to assess what can be gained from the talks by the majority of the population, and as a result the responses of the government, beyond its overarching position, are driven essentially by minority and vested interests. Thus, the only mitigation initiatives it has actively supported and pushed for, such as CDM and REDD+,

are driven by prospects of narrow economic gains for groups with vested interests—often at the cost of India's most marginalized communities. Collectively, the governments of the world have so far failed to respond to climate change in any meaningful manner.

3. *Government policies on crucial sectors, particularly energy, are worsening the situation:* Even as these processes unfold, the Indian government is pursuing other policies that will exacerbate an already bad situation. The energy sector, in particular electricity production, is one of India's biggest polluters. However, the government is now pushing for a rapid increase in generation capacity, ostensibly in order to meet the needs of under-served sections of the population. This capacity increase is primarily being done through highly destructive forms of electricity production, such as coal-fired thermal power plants and large hydroelectricity projects, both with proven adverse environmental as well as social and economic impacts. Such impacts affect both the area around these plants and much wider areas, as a result of pollution caused by increased emissions. While renewable energy projects are increasing in number and capacity, these projects too are run in a manner that greatly affects local communities. The government's subsidy policies and energy planning methods perversely encourage destructive practices in both non-renewable and renewable energy production. Meanwhile, the justification for the enormous takeover of land, water and forests in the name of expanding electricity production is hollow: the growth in electricity supply at present does not cater to the very large number of people who have either very poor electricity supply or none at all. Much of the new production is unlikely to ever materialize, and even if it does, its costs will far outweigh its benefits in the present system. It appears that the interests of financial speculators, corporations and a small elite

minority heavily influence the planning, projection and resource allocation processes. While it is true that increased electricity supply is a vital need for many in India, these policies will not produce that outcome.

Coal and thermal power in particular have a highly destructive impact: both coal mines and coal-fired power plants devastate the areas in which they occur, and lead to severe impacts on much wider areas. Millions of people have lost their lands or homes, or have seen their agriculture and livelihoods badly disrupted and destroyed, by the adverse impacts of coal. Yet, it is this form of power production that the government proposes to expand at an extremely rapid rate over the next few decades. Moreover, this form of energy production is subsidized, which in effect incentivizes the process of destructive and elite-driven energy production.

4. *The government's claims on mitigation and adaptation do not match with reality:* While the Indian government claims abroad to be engaged in massive programmes for both mitigation of, and adaptation to climate change, these claims do not match with reality. Notwithstanding the National Action Plan, in practice the mitigation efforts of the government have so far been limited to promotion of projects under the Clean Development Mechanism as well as new forestry programmes (for which international support through REDD is envisaged). CDM projects cannot, logically, be seen as mitigation efforts in India, when they are simultaneously being used to offset emissions elsewhere. In any case, the estimates of emissions reductions from these projects are highly dubious and are not verified in any transparent and accountable manner. The forestry drives are rooted in oppressive and autocratic structures of forest administration (despite a participatory veneer through Joint Forest Management) that will increase land grabbing

from forest dwellers, intensify conflict and otherwise cause injustice. Moreover, it is not clear whether these structures will complete their programme targets in any case, and whether those targets will lead to the projected emissions mitigation. In sum, instead of planning the forms of mitigation that will actually benefit the majority of Indians, and then justifiably demanding that the industrial countries supply financial resources for these policies, the government is catering to small vested interests and their financial demands. In the process it is also undermining its own position on equity and historical responsibility, since these fake and destructive 'offset' mechanisms grant the industrial countries even more space to emit carbon dioxide.

The overall conclusion is therefore clear. There is a need for a major overhaul of the Indian government's domestic policies on climate change and energy in particular, and its economic growth pattern in general, if we are to avoid a catastrophe for millions of people in the decades to come. This change, moreover, must take place regardless of international agreements and questions of emissions cuts. This is not a small challenge, but it is a vital one, and the government cannot postpone confronting it any longer.

6.2 Suggested Ways Forward

The central theme that emerges from this study is that the constant refrain of the government—that a high-emissions, high-growth, high-consumption and highly unequal economy should be the national goal—is not consonant with India's needs. This kind of economy not only does not meet the needs of the vast majority of the population; it actively works against their interests and increases the destruction already being caused by the impacts of climate change.

Clearly, then, a different approach is required. In the discussions of this report, some pointers towards this approach emerge. These include the following:

New Policies on Energy

The energy sector (particularly electricity production) is crucial to the economy, to India's emissions trajectory, to the livelihoods of millions of people and to the development needs of all. But the present policies of the government are indifferent to all of these requirements. Therefore, drastic changes are required.

First, it is clear that all technologies—whether renewable or not—begin to show increasing negative impacts when centralized and built at a large scale. On balance (though not in all situations), decentralized energy production in the form of regional or local grids is, therefore, more favourable to social and democratic requirements. Such production may lead to fewer economies of scale, but such economies are not particularly great in the case of most renewable technologies (and, in the case of hydroelectricity, are offset by the huge social costs of large dams). In fact, those forms of production for which economies of scale make centralization vital—thermal and nuclear power plants—tend also to be the most destructive ones.

Second, three forms of electricity production in particular—coal, large hydroelectricity and nuclear—are extremely destructive and inflict a huge current and potential cost on the atmosphere, the country, affected people and the economy. The government however continues to claim 'that there is no alternative' to these technologies. This is not in fact the case. It may be quite feasible to replace the existing coal generation capacity to a great extent with renewables. This is also likely to be all that is required, if power production is based on, firstly, a transparent assessment of actual ground level needs, and, secondly, transparent and accountable regulations, tariff-fixing and controls that direct energy to where it is actually most needed. The exact manner in which this should be done, and over which time period, will need extensive planning; but there can be little doubt that the current path is wrong.

The usual response to proposals such as this is that too much use of renewable energy, and/or replacing coal in general, would

be too expensive. However, coal is far from cheap if one includes its enormous social, health and environmental costs, and the silent, brutal and often illegal manner in which those costs are dumped on India's most marginalized communities. Moreover, even in narrower financial terms, the withdrawal of the subsidies being provided to coal mining and coal-fired power plants (both directly, in the form of tax deductions and favourable credit, and indirectly, in the form of subsidized land and water) will itself generate considerable revenues that can then be used to effect the switch-over.

This, as one can reasonably expect, will not be an overnight process; it will take time, planning and effort. It must also be emphasized, as discussed below, that merely trying to change the source of energy production in the absence of a change in control and planning will result in additional expense and more destructive impacts.

Third, on the same lines, subsidies of consumption need to be better framed so as to promote consumption by the majority and not by the elite. In the Integrated Energy Policy, the government has already stated that 'lifeline' energy supplies—as needed by households—must be guaranteed regardless of ability to pay. A universal system of guaranteed minimum electricity supply can be put in place to meet these needs. For domestic consumption at levels higher than the base, tariffs should be progressive in nature, starting at very low levels and then increasing in order to put a greater burden on higher end consumers. This will disincentivize wasteful forms of consumption and also partially reflect the real costs of such consumption. Industrial and institutional usage will also need regulation. Similarly, general financial policies that aim to curb speculation and promote production of mass consumption goods for the domestic market would likely have the side benefit of reducing overall energy consumption as well.

Fourth, both energy production and consumption demand democratization in terms of control. Rather than centralized planning on the basis of grid usage and fixed targets, which rarely takes into account ground realities of either production or consumption,

there is a need for democratic planning of energy use and production, where estimates are made from the local area upwards. Technologies such as regional and local grids, collective and democratically owned forms of electricity production, and regional democratically administered grids can also contribute to this process. In the absence of this, fatal absurdities such as the construction of 168 dams in Arunachal Pradesh will continue.

India's Position in the International Arena

As discussed earlier, the government's position on the historical responsibility of the industrial nations for emissions, and the principle of 'common but differentiated responsibilities' in addressing climate change is correct in principle and needs to be defended. Yet, this purely defensive articulation is not accompanied by any actual attempt to plan India's needs in terms of finance, carbon emissions and development processes. Instead, the only domestic planning to have occurred so far—the National and State Action Plans—represent neither a meaningful assessment of the climate crisis nor of the options before India.

As a result, the government's negotiating strategies often end up being in direct contradiction to its stated negotiating position (such as on REDD+ and the Copenhagen Accord). The correct insistence on climate finance (and possible reparations) has been accompanied by eager endorsement of essentially sham CDM projects by Indian corporations—undermining the government's stand and credibility.

At the root of this problem lies the fact that the government does not treat climate change as a domestic challenge at all. Neither is it willing to recognize that the current development path does not serve the majority of the country's population, and in fact causes more harm than good. What is required is an open, coordinated and systematic effort: first to assess the likely impacts of climate change on India's people; second, to plan the measures needed to counter those; and finally, transparent and democratic

decisions on how the country's development plans can be adjusted to this reality (and to the actual needs of the population). Only after such an exercise can the government accurately assess what it can and cannot agree to, and how the financial benefits it seeks can best be targeted. This could be the basis for a more proactive negotiating strategy.

The international negotiating process, if it leads anywhere at all, will eventually lead to a global cap, whether or not (as India desires) this is preceded by a formula for sharing of carbon space. Thus, merely continuing with a defensive position, while massively expanding destructive and unjust 'development' projects to serve vested interests, will only lead to an eventual situation where the costs of mitigation, adaptation and climate change itself will all be borne by the poor majority.

Adaptation to the Impacts of Climate Change

At present, awareness of and planning for the impacts of climate change is practically non-existent in both official circles and among the general public. This situation cannot be allowed to continue. Two steps are immediately required. First, communities that are especially vulnerable to climate change—such as coastal and mountain communities—need to be contacted and given information on the changes that are already visible and which are now more or less irreversible. Second—as is already required for the administration of welfare schemes and development projects in general—a democratic process of planning is needed, whereby each community (in rural areas) and each ward (in urban areas) is engaged in order to decide how existing schemes (and new interventions) can be altered in order to meet the new requirements.

Such interventions can include using existing and new schemes for:

1. *Agriculture*: Better watershed management and environmentally suitable changes in crops to adapt to climate change;

2. *Coastal areas*: Measures to tackle loss of land and lives in case of inundation and rising threats from natural disasters in general;
3. *Mountain regions*: Encouraging of localized water storage, promotion of appropriate agricultural practices, etc.

Such steps are required on a war footing if we are not to lose thousands or tens of thousands of lives to the combination of climate change-induced devastation with the deadly impacts of economic processes that are already underway.

Black Gold to Black Curse

Coal and Coal-Based Thermal Power in India

Soumya Dutta

Coal was the fuel that started and powered the initial decades of the Industrial Revolution. It was instrumental in sharply escalating the energy consumption of human societies as well as in kickstarting industrial-capitalist society's growth and dominance of the world.

Prior to coal, wood was the dominant fuel for human societies for millennia, with other biomass playing a supporting role. The comparatively recent discovery and large-scale use of coal (followed by petroleum and natural gas) was spurred by several factors. First was the overexploitation of wood and biomass due to growing energy and construction-related use, resulting in deforestation and scarcity. Second, coal has a much higher energy density (heat content per unit weight) as compared to wood and other biomass. Typically, on being burned, hard coal provides about 25–30 mega joules per kilogram, almost double the heat produced by air-dried hard wood (about 12–14 mega joules per kilogram).¹ Third, and possibly most important, the Industrial Revolution demanded high energy density fuels for steam powered machines such as railway locomotives, steam pumps, mechanical grinders and so on. This use of machinery shifted human energy use from largely grown-carbon biomass fuels and

renewable energy (flowing air and water) to an overwhelming dependence on fossil-carbon fuels. The shift occurred over the short period of about two centuries, from 1750s to 1950s.

There is hardly any record of early coal use in India, though one report claims that the first coal mining in India took place in 1744, in the Raniganj coal-fields in today's West Bengal.² According to E.R. Gee (1940):

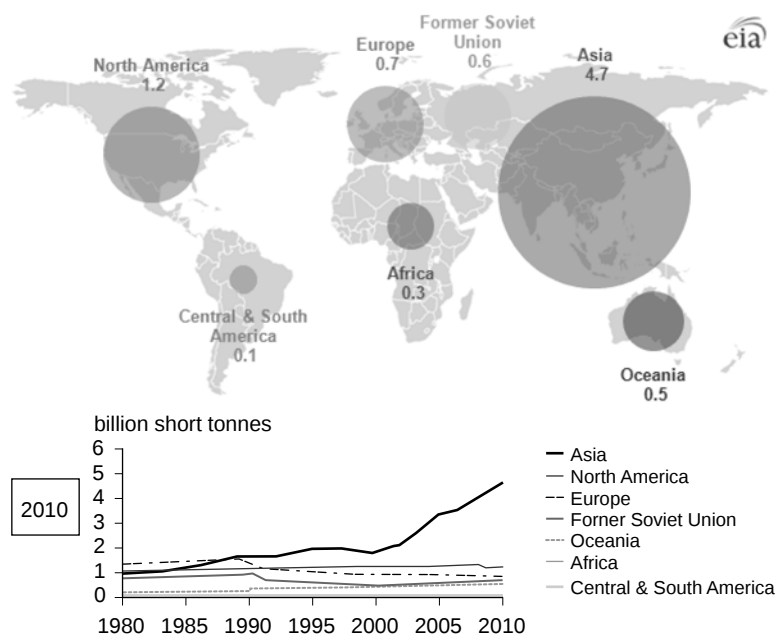
The coal mining industry of India is a relatively recent development as compared with that of many European countries. The first published reference to the mining of coal in India dates back to the year 1774, during the time of Warren Hastings, when permission to work coal mines in Bengal was accorded to John Summer and Suetonius Grant Heatly. As a result, mines, doubtless as open or incline workings, were reported to have been developed in the Raniganj field; at Aitura (Ethora) possibly in the Dishergarh seam, at Chinakuri near the Damodar river, doubtless one of the middle Raniganj seams; and at Damulia also near the Damodar, apparently in the Nega-Raniganj seam... Some 2500 mounts were delivered to Government in 1775. The latter reported it to be of poor quality. As a result of various vicissitudes, this original adventure apparently ended in failure.

No further attempt was made to exploit coal in India for nearly 40 years, until 1814, when mining was commenced near Egara (Raniganj). Although this effort was again temporarily unsuccessful, sufficient interest was aroused to encourage further exploration and between 1820 and 1825 a number of mines were opened.

From these comparatively recent beginnings, the average annual coal production in India grew to about 300,000 tonnes by 1860. This was followed by a large expansion, with production reaching over eight million tonnes by the end of the first decade of the 20th century (with 3.5 MT coming from the Raniganj fields alone) and supplying most of India's commercial energy. At the time of independence, annual coal production in India just exceeded 30 million tonnes (*Ibid*).

A1.1 Huge Coal Consumption: Massive Pollution and Climate Change

From this late and modest beginning, today India has become the third largest coal producer and user in the world (behind only China and the

FIGURE A1.1: World Coal Production by Region, 1980–2010

Note: With less than 2 million short tonnes in total production, the Middle East was by far the smallest coal producing region—only 1/57 as large as the next smallest region—and was too small to show on the map.

Source: U.S. Energy Information Administration, *International Energy Statistics*.

USA). India produced 550 million tonnes of coal in 2009 (out of a total world production of about 6900 million tonnes of combined hard coal and lignite). India imported a further 66 MT; a total of 626 million tonnes was hence used in the country in that year (IEA 2010). Along with the consumption of other big Asian economies, particularly China (which alone accounts for about 50 percent of world's hard coal use), this has resulted in over 65 percent of global coal production taking place in Asia (see Figure A1.1). The adverse consequences of this are now evident in terms of environmental and social degradation.

In 2010, world hard coal production increased by 6.8 percent, as compared to 1.8 percent in 2009. About 68 percent of this production is consumed by the power sector for generation of electricity. The

next largest shares go to the steel (around 12–13 percent globally, at over 800 million tonnes) and cement industries.

TABLE A1.1: Top Ten Hard Coal Producers (2010e)

PR China	3162Mt	Russia	248Mt
USA	932Mt	Indonesia	173Mt
India	538Mt	Kazakhstan	105Mt
Australia	353Mt	Poland	77Mt
South Africa	255Mt	Colombia	74Mt

Notes: e = estimated, Mt = Million tonnes

Source: <http://www.worldcoal.org/resources/coal-statistics/>

Roughly 42 percent of the global electricity generation comes from hard coal and lignite.

TABLE A1.2: Countries Dependent on Coal for Electricity Production

South Africa	93%	Kazakhstan	70%	Morocco	55%
Poland	90%	India	69%	Greece	55%
PR China	79%	Israel	63%	USA	45%
Australia	76%	Czech Rep	56%	Germany	44%

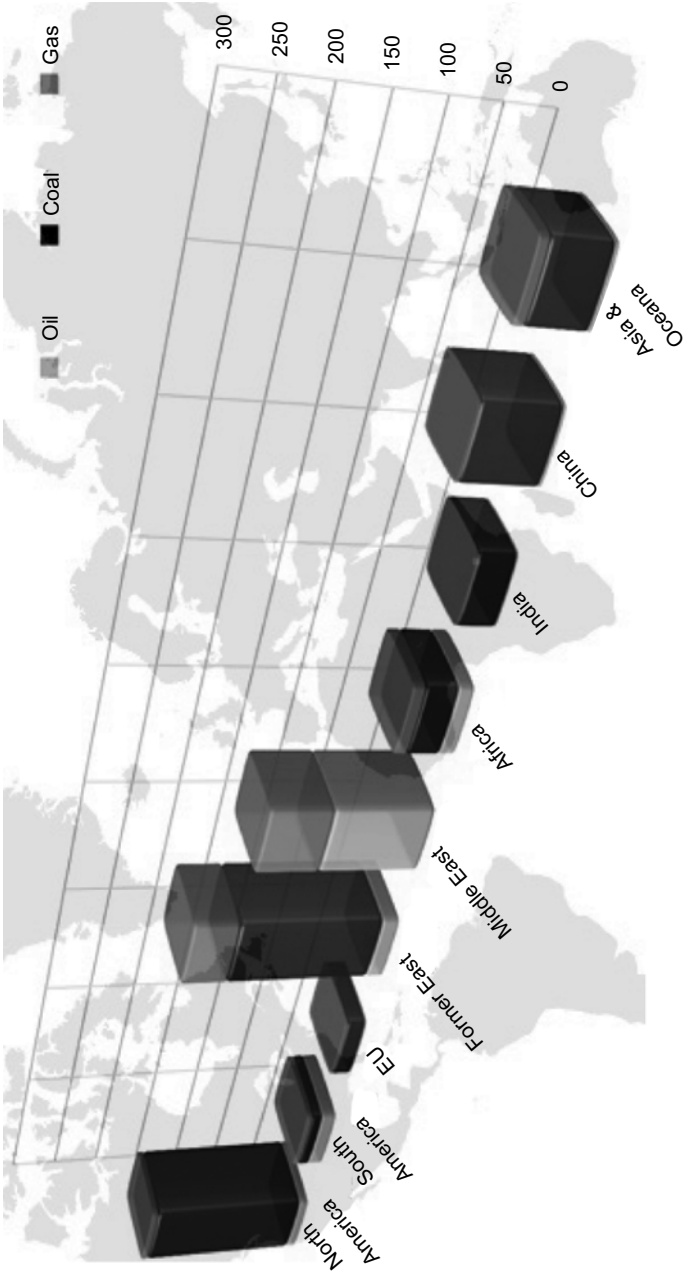
Source: <http://www.worldcoal.org/resources/coal-statistics/>

The continuing rise in coal use is also driven by the fact that proven coal reserves are larger than either petroleum or natural gas reserves, and are found much more widely, as well as being inside or close to large consumer countries. The total global ‘proven reserves’ of coal are around 900 billion tonnes, or about 115–118 years’ supply at the current rate of consumption.

Coal and Thermal Power

Coal contributed to nearly 42 percent of all electricity generated in the world in 2008 (IEA 2010). Total world electricity generation in 2008 stood at over 20,000 TWhr (terawatt hours, or billion kilowatt

FIGURE A1.2: Global Coal Reserves



Source: <http://www.worldcoal.org/coal/where-is-coal-found/>

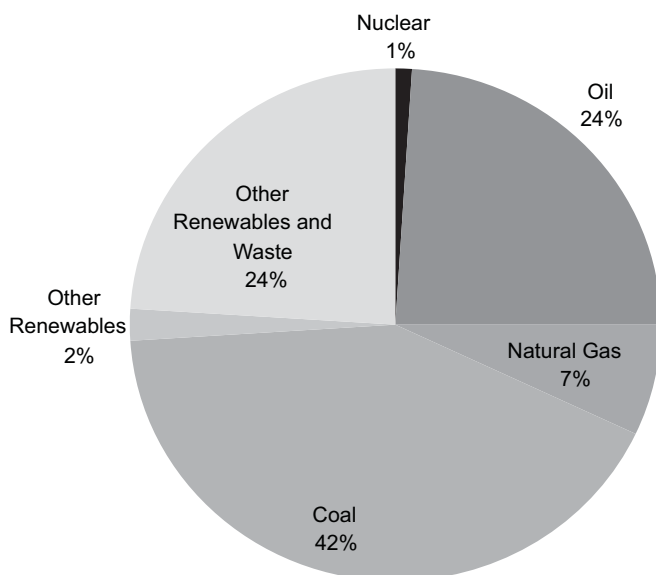
hours, a kilowatt hour being the 'unit' that households are billed on). Out of this, the total thermal power generation (coal, natural gas, heavy fuel oil and some biomass) accounted for nearly 69 percent, with about 16 percent coming from hydroelectricity, about 12–13 percent from nuclear and the remainder from other sources, including renewables. Out of the total thermal power generation of about 14000 TWHr, fossil carbon fuels contributed about 13,650 TWHr (97 percent), out of which in turn coal accounted for 59 percent, natural gas for 30 percent and oil for 7 percent, with the remainder mainly being from combustible biomass (*ibid*). Going by the installed capacity figures, global generating capacity is close to 5000 GW, out of which USA has the biggest capacity of nearly 1000 GW, followed by Europe at 800 GW, China with 750 GW, Japan at 278 GW, Russia around 225 GW and India far behind at about 185 GW. In terms of per capita consumption of power, India stands at less than 700 KWHrs per capita per year, compared to the global average of about 3000 KWHrs, while European averages range from 6500 to 10,000 KWHrs. The USA consumes around 13,700 KWHrs per capita (*ibid*). From 2006 to 2011, both the absolute and the percentage contributions of renewable sources to the primary energy supply have increased, but coal still rules as primary source of electricity.

A1.2 The Indian Scene

As stated earlier, India's dependence on coal for both total primary energy and electricity is even more stark than the world scene. This is also due to large indigenous coal reserves (estimated at around 90–110 billion tonnes up to a depth of 600 metres).

This is about 10 percent of world reserves, though most Indian coal is of an inferior quality (GSI n.d.). The Geological Survey of India estimates that India has a reserve of 211 billion tonnes, if coal found at up to 1200 metres depth is included, with proven reserves of 83 billion tonnes (*ibid*).

The above figure is notable because a fairly large share of India's primary energy needs is still supplied by combustible, non-commercial

FIGURE A1.3: Total Energy Consumption in India

Source: IEA (2011).

biomass; the amount produced from biomass is roughly equivalent to the share of India's energy consumption derived from petroleum (Planning Commission n.d.), which receives massive attention and subsidies—while biomass does not. If biomass is excluded from the comparison, the share of coal in primary energy sources jumps to about 55 percent. This is better illustrated in the Planning Commission data (Table A1.3).

According to British Petroleum, 'Demand for coal in India is growing at a particularly fast rate. For decades, it has been running much higher than the world average. Between 1976 and 2006, domestic coal consumption rose by 5.3% a year, versus 2% for the world. In recent years, average annual growth has accelerated sharply, exceeding 8% a year since 2003' (BP 2007). About 88 percent of India's coal consumption is from indigenous sources (GSI n.d.). This compares well to the petroleum consumption of about 3.2 million barrels per day, of which indigenous production accounts for only 950,000

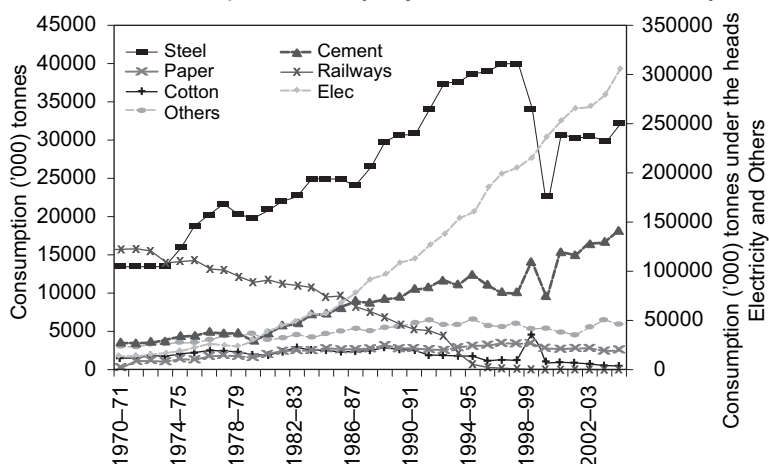
TABLE A1.3: India: Primary Energy Consumption Mix in 2007–08³

Energy Type	Units	in Original Units	in Mtoe	% share in Primary Commercial Energy	% share in Total Primary Energy Consumption
Coal	Mt	501.52	215.48	53.54	39.50
Lignite	Mt	34.65	9.71		
Oil	Mt	139.73	139.73	33.22	24.51
Natural Gas	BCM	32.27	29.07	9.34	6.89
LNG	Mt	8.24	10.21		
Nuclear Power	MkWh	16777	4.38	1.04	0.77
Hydro Power	MkWh	128702	11.07	2.63	1.94
Wind Power	MkWh	11410	0.98	0.23	0.17
Primary Comrcl Energy	Mtoe	-	420.62	100.00	73.78
Non-Comrcl Energy	Mtoe	-	149.50	-	26.22
Total Primary Energy	Mtoe	-	570.12	-	100.00

Source: Planning Commission (n.d.).

barrels (CIA n.d.). Indeed, present day annual petroleum consumption in India is over 150 million metric tonnes, but indigenous production supplies only about 34 million tonnes (CIA n.d.; CGES 2011). Thus, over 70 percent of oil consumption has to be imported, causing considerable strain on the economy. This also puts additional pressure on coal production, as new sectors such as coal-to-liquid (CTL) and coal gasification energy technologies are opened in an attempt to make up for these projected ‘shortfalls.’ This, in turn, drives up India’s carbon dioxide emissions and other coal-related pollution, following the Chinese pattern. Apart from the main end-use of power generation, coal in India is used by many energy-intensive industries, with steel being the largest consumer followed by cement and paper. This is illustrated by Figure A1.4.

India has a total installed electricity generation capacity of about 186,000 MW at the end of 2011 (MoP n.d.). Electricity generation rose from approximately 5 billion KWHrs in 1948 to 420 billion by 1998, and rose to about 900 billion in 2011 (Indian Power Sector n.d.).

FIGURE A1.4: Consumption of Coal by Major Sectors of the Indian Economy.

The current sources of electricity generation in the various regions of India are given in Table A1.4.

This capacity is divided between the Central, State and the private sector in the proportions as given in Table A1.5.

For the 104 GW of coal-based thermal power, the annual coal consumption required is 410–420 million tonnes, which accounts for about two-thirds of India's total coal consumption (640 million tonnes). With Indian coal having an ash content of nearly 40 percent, this means an annual disposal of over 160 million tonnes⁴ (approximately 20 million or two crore standard truckloads) of toxic ash from the power sector alone. This has grave environmental and health consequences in and around mines, power plants and dumping sites.

A1.3 Disparities, Discrimination and Deception: India's Energy Consumption

India's per capita annual electricity consumption (700 KWHrs) and primary energy consumption are still much lower than the world averages—not to speak of the 'developed' country averages. Thus, the global average for electricity consumption is approximately 3000

TABLE A1.4: All India Region-wise Generating Installed Capacity (MW) of Power Utilities

Region	Thermal				Nuclear	Hydro	Renewable Energy	Total
	Coal	Gas	Diesel	Total				
Northern	26932.50	4171.26	12.99	31116.75	1620.00	14922.75	3509.56	51169.06
Western	34923.50	7903.81	17.48	42844.79	1840.00	7447.50	5937.60	58069.89
Southern	20982.50	4690.78	939.32	26612.60	1320.00	11338.03	10128.96	49399.59
Eastern	21122.88	190.00	17.20	21330.08	0.00	3882.12	356.42	25568.62
N. Eastern	60.00	787.00	142.74	989.74	0.00	1158.00	223.60	2371.34
Islands	0.00	0.00	70.02	70.02	0.00	0.00	6.10	76.12
All India	104021.38	17742.85	1199.75	122963.98	4780.00	38748.40	20162.24	186654.62

Note: Captive Generating Capacity Connected to the Grid (MW) = 19509

Source: MoP (n.d.)

TABLE A1.5: Sector-wise Total Installed Capacity

Sector	MW	Percentage
State Sector	83,605.65	44.79
Central Sector	57,732.63	30.93
Private Sector	45,316.34	24.27
Total	186,654.62	

KWHrs (IEA 2010). To make matters worse, it is only a rising rich (and middle class) with continually increasing energy demand which fuels the explosive 'demand and consumption growth' in all energy sectors in India. The government and big business always point to population increase as a major factor in energy and materials demand. In reality, there is a direct correlation of energy demand with income growth, but there is a much weaker correlation with population growth. As the *BP Energy Outlook 2030* says, 'Since 1900 world population has more than quadrupled, real income has grown by a factor of 25, and primary energy consumption by a factor of 22.5' (BP 2012). Even in the more recent past, from 1970 to 2010, this relationship between income and energy consumption holds (Table A1.6 and A1.7).⁵

TABLE A1.6: Relationship between Income and Energy Consumption (World)

	Population	GDP	Primary Energy Consumption
1970	~3.7 billion	~24 Bln USD (PPP)	~4 billion toe
2010	~6.8 billion	~72 Bln USD	~11.6 billion toe
Increase	1.83 times	3 times	2.9 times

The same holds largely true for India:

TABLE A1.7: Relationship between Income and Energy Consumption (India)

	Population	GDP (USD billions)	Primary Energy Consumption
1980	~680 million	~182 billion	~140 million toe
2010	~1100 million	~1300 billion	~640 million toe
Increase	1.61 times	7.14 times	4.57 times

If we take a look at the per capita consumption of major commercial energy by sources (Table A1.8), and compare this to the percentage of the population in India having very little or no access to these, this skewed nature of ‘development’ becomes starkly clear (MoP&NG 2011).

TABLE A1.8: Per Capita Consumption of Major Commercial Energy by Source

	Electricity	Petroleum	Natural gas
Per Capita Consumption	~680 Kwh/Y	~125 Kgs/Y	~1600 SCFt/Y
Percentage of Indians with little or no direct access	~ 38%	~45%	~ 70–75%

At the same time, many of the poor Indians, who have little or no access to these commercial energy sources, have to pay a higher price for cooking and other fuels than the power companies pay for coal. For instance, with fuel wood, consumption may average 600–900 kilograms per year per family, but such wood often sells for ₹2–3 per kilogram.⁶

It helps to keep in mind that the Arjun Sengupta Committee report (NCEUS 2007) found that nearly 77 percent of Indians have a spending capacity of ₹20 or less per person per day (in 2003–4 values, which today would be around ₹32). Thus, rapid growth in both income and primary energy consumption benefits only a minority of well-off Indians, and puts further pressure on the remaining 80 percent.

Notwithstanding this reality, unbridled and fast GDP growth continues to be the prime development objective of our planners, and this worldview is reflected in almost all state and corporate statements, policies and actions on the power front. Note the following passage from ‘Through the Plans,’ a Planning Commission document that was prepared as part of the process of framing the National Energy Policy:

India’s primary energy use is projected to expand massively to deliver a sustained GDP growth rate of 9% through 2031–32 even after allowing for substantial reduction in energy intensity. In order to fuel this on sustained basis, the growth of around 5.8% per year in primary energy

supply including gathered non-commercial such as wood and dung of would be required. Commercial energy supply would need to grow at about 6.8% per annum as it will replace non-commercial energy, but this too involves a reduction of around 20% in energy use per unit of GDP over a period of ten years. *Requirement of India's dominant fuel Coal including Lignite will expand from around 500 million tonne in 2006–07 to over 2.5 billion tonnes per annum* based on the quality of available domestic coal over a period of 25 years. The primary energy use by 2031–32 will increase by 4 to 5 times and *Power generation capacity would increase six-folds from the 2006–7 level of around 160,000 MW* inclusive of all captive plants. (emphasis added)

The U.S.-based World Resources Institute draws a slightly different picture (Bairiganjan et al. 2010):

India is facing a severe energy crunch. *Roughly four hundred million rural inhabitants—more than the entire U.S. population—still lack electricity*, making energy access a development imperative. At the same time, economic growth is sending national energy requirements soaring. India's GDP is on pace to grow by 8% in 2010, and domestic energy demand is predicted to more than double by 2030. *The energy shortage is most acute among India's rural poor, the majority of whom rely on relatively inefficient, polluting and health-threatening fuels such as kerosene and firewood for their lighting and cooking needs.*

It then goes on to describe a great profit making opportunity from this deprivation:

India, a rapidly emerging economy with the world's second largest population, is facing a surging energy demand. Its rural Base of the Pyramid (BoP) consists of 114 million households, representing 76 percent of India's rural residents and almost 60 percent of the country's total population. *Despite their low income, these households constitute a significant consumer market for the energy services and products required to provide daily necessities such as cooking and lighting.* Using the most recent available expenditure data (2004/2005), we estimated that India's rural BoP consumers spent INR 224 billion (US\$4.86 billion) per year on their energy needs. In 2005, approximately 45 percent of India's rural BoP households still did not have reliable access to electricity and relied on kerosene for lighting, and *more than*

85 percent of rural BoP households mostly used conventional free or inexpensive sources of fuel, such as firewood and dung, for cooking. These fuel sources, however, are not only harmful to users' health but also contribute to pollution and environmental degradation.

Instead of maintaining the energy and fuel security of the poor (who have 'mostly used conventional free or inexpensive sources of fuel') through ensuring continued access to free or inexpensive fuels without health hazards, state and corporate plans only aim to force them into the commercial fuel market. The effect this will have on their food and energy security is not seen as an issue of concern. Given the size of the population concerned, even a small profit margin will generate big profits.

For instance, many of the private solar power companies have been aggressively promoting the commercial 'viability' (with 'financial innovations') of small rooftop solar PV-based lighting systems, which will supposedly provide a 'lifeline' electricity supply for the roughly 36 percent of households in India who do not have electricity. That number translates to 80–90 million poor households/families. A small solar photo voltaic-based (2-CFL+ mobile phone charging) lighting system, sold for even ₹10,000 (with whatever financing scheme), translates to a market opportunity of ₹80,000 to 90,000 crore (USD 16–18 billion). A modest 15 percent profit margin on that would in turn translate into 12,000 to 13,500 crore of profit—demonstrating the potential of this model. Similarly, millions of households are still using locally gathered and low-cost local biomass, but are being pushed to the commercial cooking fuel market—another big 'market opportunity.' Thus, rather than the well-off being asked to bear the burden of currently more costly renewable systems, the burden of these systems is being put on the poor.

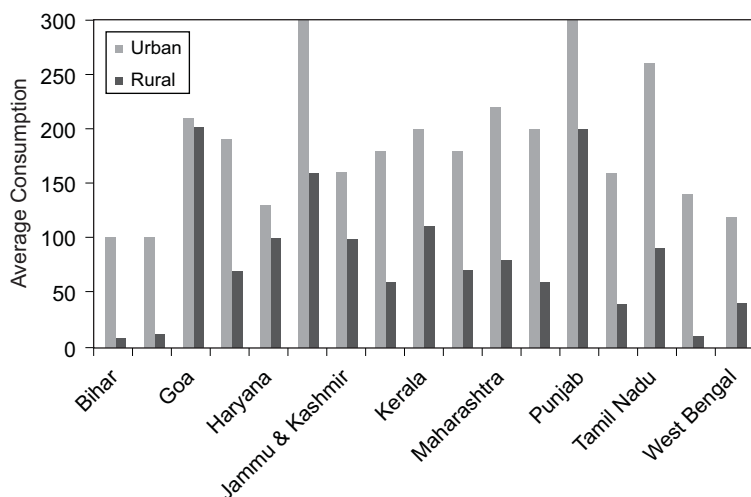
Energy, But Not for the Energy Deprived

In 1995–96, when the liberalization-privatization-globalization process started taking hold of the Indian economy, the installed power generation capacity in the country was a little over 81,000 MW. At this time, roughly 50 percent of Indians had no access to electricity.

In 2010, by which time the installed power capacity had more than doubled to about 172,000 MW,⁷ 36 percent of Indians still had no electricity (Krishnaswami 2010). Another 33 percent of Indians had electricity on paper, but these households accessed a miniscule 50 KWHrs or so per person per year (*ibid*). In sum, over 70 percent of the people of India have little or no electricity access, in spite of 'sustained GDP growth' for many years and a nearly three-fold increase of installed generation capacity from 1991 to the present day. During the same period, Delhi's power consumption shot up from around 2000 MW in 1996 to over 5000 MW in 2010. Consider further that Delhi's population increased by about 70 percent between 1996 and 2011, but power availability for the capital increased by 150 percent. In short, per capita availability in Delhi doubled, with most of this extra power being captured by the privileged (GoD 2009 and 2010).

The same story repeats itself all over India. The picture will be yet starker if one takes into account figures from the rural areas of Bihar, Madhya Pradesh, Jharkhand, Chhattishgarh, Odisha and so on—the real 'base of the pyramid,' where both the state and the private sector

FIGURE A1.5: Rural-Urban Electricity Consumption Distribution

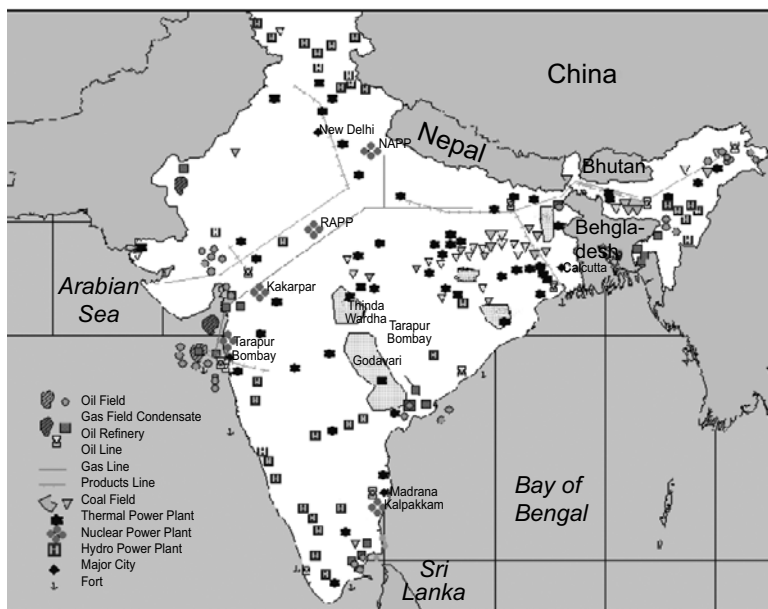


Source: Krishnaswami (2010).

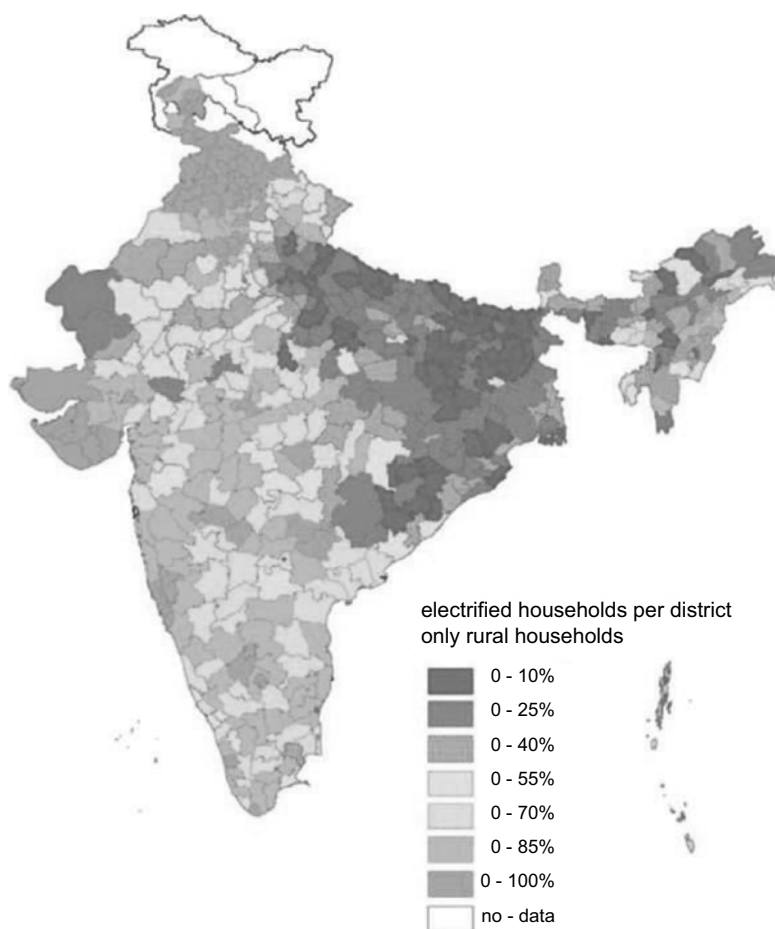
power companies want to make their multiple gains. Hence, the excuse that the present frenzied power and energy capacity increase is needed to provide energy to the vast numbers of deprived Indians (a very ‘popular’ and oft-repeated excuse) is obviously a false one, a disguise that hides the energy gluttony of the rich. IEA data for 2009 indicates that ‘electrification rates for India were 66 percent for the country as a whole. *Ninety-four percent of the 404 million that do not have access to electricity live in rural areas*, where electrification rates are approximately 50 percent’ (IEA 2009). Within States as well, there is a strong bias in favour of electricity provision to urban areas.

The next two figures (A1.6 and A1.7) show this contrast even more starkly. The first is an energy map (GENI 2010) that shows the concentration of coal and hydropower resources in the eastern part of the country, while the second shows the extreme discrimination

FIGURE A1.6: Energy Map of India showing Distribution of Coal and Hydro Power Resources



Source: GENI (2010).

FIGURE A1.7: Percentage of Electrified Rural Households

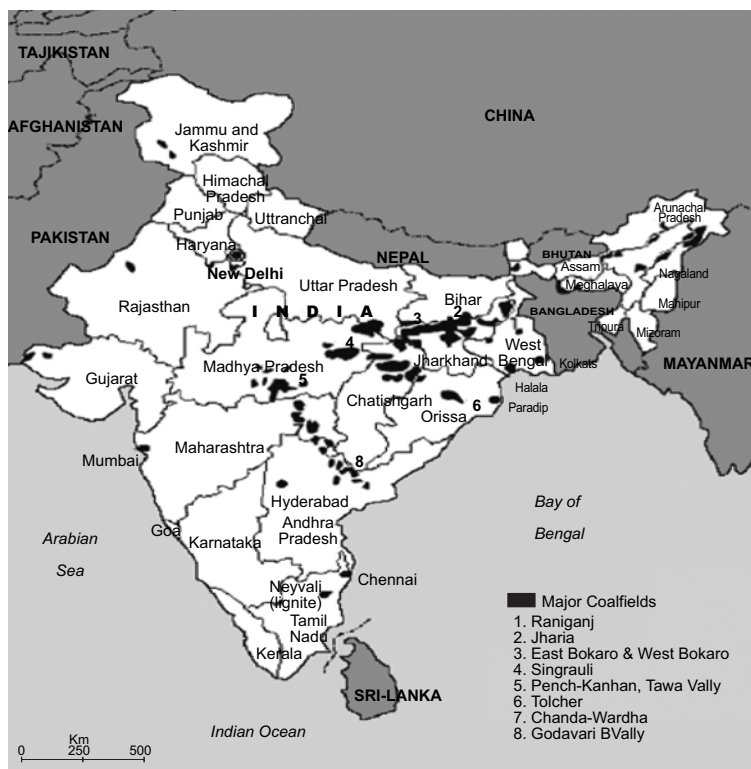
Source: Krishnaswami (2010).

and deprivation in providing electricity to the rural people living in the same regions (Krishnaswami 2010). Not entirely coincidentally, this is the area known as the red corridor, which has been witnessing intense political unrest for the last few decades. This includes an armed struggle by Maoist guerillas, which is being sought to be suppressed by a much larger armed response by the government.

Huge Land Grab and Displacement—Massive Forest Destruction

Such energy deprivation is not the only damage being wreaked by the current thermal-dominated electricity generation regime. Large amounts of land are acquired forcibly and by deceit from these same deprived people for power plants, coal and iron ore mines and hydro-electricity reservoirs. Millions have been forced out of their homes and livelihoods, and large tracts of pristine forests and natural habitats have been destroyed. The major coal mining areas (dark patches in the map below—Figure A1.8) are inhabited largely by the country's adivasi or tribal (indigenous) populations. These communities depend on forest and other natural resources to a great extent. They are also

FIGURE A1.8: Major Coalfields in India



the most deprived in energy terms, despite large amount of coal is mined from their lands and burned. Moreover, they have to face the maximum damage, in terms of health impacts and loss of access to resources and livelihoods, as a result of snatching away of their homes, fields and forest commons.

According to a study released by the Centre for Science and Environment in 2011 (*Down to Earth* 2011), in the last 30 years (1981–2011), over 830,000 hectares of forest land have been diverted for so-called ‘development’ projects, out of which 40 percent was taken over for mining and power projects. Mining alone ate up about 148,000 hectare of forest land. From 2007 to August 2011, this destruction has accelerated and about 50,000 hectare of forest land has been destroyed for mining, with coal mining alone accounting for 26,000 hectare (*ibid*). About 181 coal mining projects received forest clearance in the same Eleventh Plan period. Thermal power plants was granted 2200 hectare of forest land, with power transmission lines (essential infrastructure for power plants) receiving an extra 8383 hectare. The eleventh plan also saw environmental clearance granted to about 200 new coal-fired power plants with a planned installed capacity of 176,000 MW, in comparison to the present installed coal-power plant capacity of 104,000 MW (*ibid*).

Earlier studies have also connected coal mining with land grabbing and displacement. Thus, one study states, ‘Of the 2.13 million hectares of land in which coal is found in India, over 0.36 million hectares (16.9 percent) have been damaged due to past coal mining activities’ (*Down to Earth* 2011; Areeparampil 1996). According to B.P. Baliga, former head of the environmental engineering division of CMPDI, ‘In the 1980s the coal mining industry became identified as a major cause of damage to the environment, with more than 75 sq km of land being destroyed every year’ (*ibid*).

Mining and energy companies belonging to the private sector contribute greatly to this land grab and human displacement, as is evident from a recent report by Kuntala Lahiri-Dutt, Radhika Krishnan and Nesar Ahmad (2012), about land grabs by private coal mining companies in Jharkhand (Table A1.9).

TABLE A1.9 Displacement Caused by Land Acquisition (As declared by Mining Companies)

Company	Annual Capacity of Coal (in million tonnes/year)	Land Requirement (in hectare)	Estimated Displacement as per Environment Impact Assessment Report (Number of People/Families)
Essar Power Jharkhand (Chakra)	4.5	900	211 families
Neelanchal Ispat Nigam	1.3	383	1737
Chitarpur Coal and Power	0.68	1378	149
Eastern Mineral Trading Agency	3	491	1158
Nico Jaiswal	1	294	Not available

Source: Various EIA reports submitted by companies to PCB and MoEF, Gol, New Delhi.

The first picture that emerges from this is that such vast tracts of lands being taken away cause massive displacement in these forested and tribal areas. Women's issues researcher K. Bhanumathi says:

In India, the number of people displaced by various projects is estimated to be 50 million and of these, approximately 10 million have been displaced by mining projects alone. Seventy five percent of people displaced have not yet received any form of compensation or rehabilitation... The Land Acquisition Act of India is draconian and obsolete and gives over-riding powers to the state to encroach onto people's lands for any 'public purpose' including mining. (Bhanumathi n.d.)

Well known social researcher and activist Smitu Kothari (1995) estimates that 'since independence...development projects of the Five-Year Plans have displaced 0.5 million persons each year primarily as a direct consequences of administrative land acquisition.' He goes on to note that this also leads to 'the dismantling of traditional production systems, desecration of ancestral sacred zones, graves and places of worship, scattering of kinship groups, disruptions of family system and informal social network.'

Further, as per a study entitled *Development Induced Displacement of Women*, 'the Twenty-ninth Report of the Commissioner of

Scheduled Castes and Tribes (1990) says that even though tribal people are roughly 7.5 percent of the population, over 40 percent of those displaced till 1990 belonged to these communities. A report of the Official Working Group on Development and Welfare of Scheduled Tribes during the Eighth Five-Year Plan (1990–1995) on the rehabilitation of tribal people, based on a comprehensive study of 110 projects, has concluded that of the 1.694 million people displaced by these projects, almost 50 percent (814,000) were tribal people' (NCW n.d.).

Indeed, the areas where the maximum coal mining clearances have been granted strongly overlaps with the adivasi areas of the country. Indeed, the additional coal mining capacity cleared in the last five years (583 million tonnes/year) is greater than the total present coal mining capacity—which has, as seen above, been created over the last 100 years. The newly sanctioned mines have sought and received 154,000 hectares of land (*Down to Earth* 2011); in addition, over 60,000 hectares has been cleared for coal power plants. The latter is again an area larger than the present total for power plants (which have been created over the last century and a half).

TABLE A1.10: Coal Mining and Environment Clearance during 11th FYP (2007–11)

State	Number of mines granted environment clearance	Capacity (in MTPA)
Andhra Pradesh	29	48.46
Assam	1	0.15
Chhattisgarh	21	102.88
Gujarat	1	0.30
Jharkhand	32	140.33
Maharashtra	32	43.14
Madhya Pradesh	35	134.95
Odisha	13	93.69
Rajasthan	4	5.50
Uttar Pradesh	1	4.00
West Bengal	12	9.87
Total	181	583.26

Source: *Down to Earth* (2011).

Not even a quarter of the mines that were cleared are actually operational. The clearances given are in great excess of even the projected targets of an increase in generation capacity (*ibid*). Further, over the last two years, the coal power industry has become much less viable at present power tariffs, as a result of a number of factors. These include the near doubling of the price of imported coal (Sierra Club India 2011), which most of the coastal thermal power plants depend on, from the main suppliers: Indonesia and Australia (*Economic Times* 2011). Coal India has also steeply increased its prices (*DNA* 2011); Coal India mines about 90 percent of India's total produced coal⁸ and is currently holding nearly another 200,000 hectare of leased land, including 55,000 hectare of forest land (*Down to Earth* 2011). A third factor is the justified rejection of several coal power plants' attempts to sell carbon credits under the UNFCCC Clean Development Mechanism (see Chapter 4) (CDM Watch 2010). As a result of these changes, the mad rush for coal mines and coal-based thermal power plants leads the Centre for Science and Environment to ask: 'Is this a land and water scam? Is this new age license scam in the non-license raj of liberalization?'

A1.4 Water, Life, Climate Crisis—Why Coal Must Be Phased Out

Both coal mining and thermal power plants have multiple adverse impacts on the environment. They emit huge quantities of carbon dioxide, as well as particulates and acidic oxides that are potentially damaging to human health and vegetation. Their effluents contaminate ground water with a variety of toxic chemicals. If one estimates a 50 percent carbon content for the coal burned in thermal power plants in India in 2010 (roughly 410 million tonnes) (World Coal Institute 2005), and add 15 percent for the energy required for extraction, processing and transport, the total carbon dioxide emission from India's coal-fired thermal power plants alone would be around 882 million tonnes. This is about 46 percent of the total emissions from the country (around 1900 million tonnes in 2010).⁹ With India being one of the 12 most vulnerable countries in regard to three of

the five climate change induced hazards, namely floods, droughts, agricultural loss, sea-level rise and storms (*IRINnews* 2012), our country (or any country for that matter) cannot afford to continue with this black curse any longer.

The vast amounts of coal burnt not only emit large amounts of carbon dioxide and other gaseous air pollutants, but also create huge amounts of bottom and fly ash. Roughly 2–5 percent of the weight of the coal burnt is released into the air as fly-ash (EPA n.d.). In just one thermal plant area in Uttar Pradesh:

Field surveys showed that 100,000 people are affected due to fly ash exposure. 50–55% is affected with asthmatic disorder due to fly ash exposure. Overflow of pond ash towards residential areas is causing unnecessary human exposure and has serious health risks due to the high content of heavy metals. The villagers are even more negatively affected when monsoon season begins, as the ash is deposited in the fields and farmers use ash-laden water to irrigate; this has an adverse affect on productivity and blocks the drainage system. (Blacksmith Institute n.d.)

Fly ash also contains radioactive materials, with concentrations much larger than those contained in coal. These include uranium and thorium as well as their many decay products, including radium and radon (which is also released from the ground) (Hvistendahl 2007; EPA n.d.). While some of these elements are less chemically toxic than other coal-burning byproducts like arsenic, selenium, or mercury, questions have been raised concerning possible risk from their radiation:

Fly ash uranium sometimes leaches into the soil and water surrounding a coal plant, affecting cropland and, in turn, food. People living within a ‘stack shadow’—the area within a half- to one-mile (0.8- to 1.6-kilometre) radius of a coal plant’s smokestacks—might then ingest small amounts of radiation. Fly ash is also disposed of in landfills and abandoned mines and quarries, posing a potential risk to people living around those areas. In a 1978 paper for *Science*, J.P. McBride at Oak Ridge National Laboratory (ORNL) and his colleagues looked at the uranium and thorium content of fly ash from coal-fired power plants in

Tennessee and Alabama. To answer the question of just how harmful leaching could be, the scientists estimated radiation exposure around the coal plants and compared it with exposure levels around boiling-water reactor and pressurized-water nuclear power plants. The result: estimated radiation doses ingested by people living near the coal plants were equal to or higher than doses for people living around the nuclear facilities. (Hvistendahl 2007)

The U.S. Environment Protection Agency’s estimates for coal ash radioactivity are given in Table A1.11:

TABLE A1.11: Coal Ash Radioactivity

Wastes	Radiation Level [pCi/g]		
	low	average	high
Bottom Ash	1.6	3.5–4.6	7.7
Fly Ash	2	5.8	9.7

In areas with large fly ash dumping sites, this level of radiation can pose radiation risks to surrounding inhabitants. Tens of thousands of toxic ash ponds the world over are thus disasters waiting to happen.

At another level, for their operation, thermal power plants consume vast amounts of water and oxygen, and both mines and power plants destroy the same forests that help ‘create’ these vital life support systems, thus reducing the earth’s pollution absorption capacity. Apart from land and forests, coal mining and thermal power plants have severe impacts on water resources. According to the CSE study (*Down to Earth* 2011), in the Eleventh Plan period alone, mining, iron and steel, cement and thermal power plants, ‘have been allocated 8.3 billion m³ of water per year. TPPs [thermal power plants] will guzzle 84 percent of this total water allocation, 7 billion m³. Iron and steel will consume another 13 percent. The rest of the 3 percent will be consumed by the other sectors together. All the water allocated is equal to what is needed to meet the daily water needs of about 250 million people (@100 lpcd).’

But even this is not the whole picture of ‘cost externalization,’ as discussed in this paper. Coal mining and thermal power plants also

TABLE A1.12: Industry-wise Allocation of Water per Annum

Sector	Water (million m ³ /annum)	Percentage of total
Cement	88.84	
Coal mining	58.3	
Iron and steel	108.08	13%
Thermal power plants	7000	84%
Other Mining	90.43	
Total	8335.65	

contribute to large-scale water contamination and pollution. Pollutants include both chemicals and huge amounts of thermal pollution.

The average thermal efficiency of India's coal-fired thermal power plants is around 29–30 percent because these plants use sub-critical steam technology (ABB n.d.). Indeed, the average efficiency has actually come down from around 29 percent in 1990 to around 27 percent in 2009, largely due to ageing coal plants. The world average, meanwhile, has gone up from 32 percent in 1990 to 35 percent in 2009, as more gas power stations have kicked in (*ibid*). This efficiency rate means over that 70 percent of the heat released by burning coal is thrown out as waste heat, with over 40 percent heating the cooling water and the remainder entering the atmosphere with the stack gas. The cooling water is also chemically polluted as a result of boiler blow-down, coal pile run-off, cooling process waste and boiler cleaning waste, among other polluting processes. Contaminated cooling water is thus discharged at 6–8 degrees above the intake temperature back into the source water body, leading to reduction of dissolved oxygen as well as general pollution. This leads to changes in the enzyme metabolism of aquatic animals.¹⁰ The combined effect of these phenomena leads to the decline of fish and other aquatic life, adversely affecting the livelihoods of large numbers of fisher-people, both on the coasts and inland.

In a reported case in the USA (*San Francisco Chronicle*, 2 January 2009), Mirant Corporation was sued for the large-scale fish and marine life damage caused by its Potrero Thermal Power Plant. However, in general, such cases are rarely allowed to go beyond local fisher-folks' complaints. As has been pointed out by the fisher-folk in

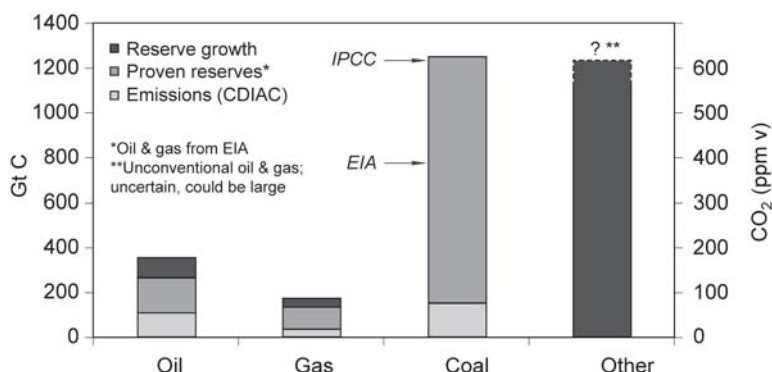
and around the Tarapur village north of Mumbai, of the 700 odd fishing boats that operated before the Tarapur nuclear power plant was set up in 1969, today there are hardly 30–35, as the fish catch has gone down drastically. This concentrated local water-body warming will compound the adverse impacts of coastal waters' global warming. In turn, it will have serious ecological and livelihood implications for even a larger number of people.

Phase Out Coal

As a result of the consumption of large quantities of coal, the environmental, economic and health damage resulting from mining, washing, transportation, ash dumping and thermal pollution of water bodies have assumed gigantic proportions in India. This is over and above the enormous quantities of carbon dioxide (the primary greenhouse gas) being emitted as a result of this massive coal use. In spite of these known 'external costs,' the astronomical revenues of the global coal mining industry—over \$4.12 billion in 2010¹¹ and growing at an compounded annual growth rate of over 10 percent—is a major road block in any attempt to reduce the share of coal in our primary energy supply. Though coal is known to be the dirtiest of all fossil fuels, world coal production is growing at around 5 percent annually (EIA 2010). Coal is often portrayed as the 'cheapest' fuel available, and it is said that there is no alternative fuel available to replace the role coal plays in our industrial societies. This 'cheapness' does not take into account coal's environmental and health costs; nor does it account for the multiple hidden subsidies to the sector.

In spite of the large reserves of coal and its wide geographic spread, there are strong reasons why coal use should be immediately stabilized at the current levels, and then phased out in the next few decades.

The strongest of these arguments is the danger of causing irreversible climate change, leading to world-wide climate catastrophe. Even by its conservative estimates and modelling studies, the IPCC-AR4 released in February 2007 concluded that, to keep the earth's climate from going into a dangerous tailspin, the atmospheric concentration of

FIGURE A1.9: Fossil Fuel Reservoirs and Emissions from 1750–2004

Source: Hansen et al. (2007).

carbon dioxide cannot cross 450 ppmv (parts per million by volume). Recent scientific studies and modelling by James Hansen and others (2009) have shown that this safe upper limit is actually closer to 350 ppmv, and the world is already well over 390 ppmv!¹² If we continue to use coal, which emits twice as much CO₂ per unit of heat produced as natural gas, and roughly three times more than petroleum, the world would soon cross the safe limit. From Figure A1.9, it can be clearly seen that just the proven reserves of coal in the world today can add another 500 ppmv to the present 390, devastating the earth's climate systems beyond recognition.

A1.5 Can Renewable Sources Fully Replace Coal and Meet All Future Energy Demand?

This question has answers at multiple levels, and a detailed analysis is beyond the scope of the present study. However, at the broadest level, it would appear that it is not only possible to phase out coal, but that this must be done as soon as possible in order to protect the earth's life support systems, as elaborated earlier. At a more complex level, there is a difference between profit-driven demand, and genuine and sustainable needs for reasonably comfortable lives for all the people

in the world. There are enough renewable energy resources available to sustain a reasonable life for people—both in India and in the world. In its well researched report (Greenpeace and EREC 2010), Greenpeace has shown that by stabilizing global energy demand at around the 2010 level, all coal and nuclear power plants can be phased out by 2050, while providing energy to all (including the roughly two billion people today deprived of minimum energy) for a quality life. This is also based on five key principles (*ibid*):

1. Implement renewable solutions, especially through decentralized energy systems,
2. Respect the natural limits of the environment,
3. Phase out dirty, unsustainable energy sources,
4. Create greater equity in the use of resources, and
5. Decouple economic growth from the consumption of fossil fuels.

This will require an aggressive pursuit of the most suitable renewable sources, along with energy efficiency increase in all possible sectors. Further, this can be done at the present level of available technology. But the key is the condition that future energy demand (in the year 2100) would not greatly exceed the level of energy production that existed in 2010. This obviously means that those living high-energy and high-consumption lifestyles have to come down the ladder of consumption, both by increasing efficiency and by engaging in a reduction in consumption. These scenarios will also require diversification of energy resources in each region, restructuring of the industrial-commercial establishment, and enabling policies and incentives.

Notes

1. See biomassenergycentre.org.uk and solidfuel.co.uk for more information.
2. Press Information Bureau, Government of India.
3. Electrical energy measured in KWh is also converted in to the thermal energy kcal or kJ using the definition and finally expressed as Mtoe (1 billion kWh = 0.86 billion calorie or 0.086 Mtoe). Taking the thermal efficiency of the power plant and other losses in the system, the equivalence between electricity and

fossil fuels would be 1 billion KWh = 0.28 Mtoe (in case of coal-fired boilers) and 0.261 Mtoe (in case of nuclear electricity). 1 billion KWh generated from hydroelectricity or wind power, however, are considered as equivalent to 0.086 Mtoe since there is no intermediate stage of heat production while using these primary energies.

4. Calculated from known figures of around four million tonnes coal consumed annually by a 1000 MW non-supercritical thermal power plant and average ash content of ~40 percent in Indian power coal.
5. 'World Development Indicators'—World Bank. <http://data.worldbank.org> and calculated from other sources, including Census figures.
6. Average calculated from fortnightly data given in *Down to Earth*.
7. Ministry of Power, GoI, and Central Electricity Authority, www.cea.nic.in.
8. <http://mining.crusherplants.com/global-mining/india-mining-construction-equipment.html>.
9. Calculated from 'Provisional Coal Statistics 2009–10,' Ministry of Coal. 'International Energy Statistics 2010,' U.S. Energy Information Administration; also reported in *Guardian* newspaper datablog.
10. 'Thermal Pollution,' www.pollutionissues.com.
11. World Coal Association data.
12. Atmospheric CO₂ concentration rose from 389.82 ppm in February 2010, through 391.76 in February 2011, to 393.65 in February 2012, as per data from Mauna Loa Observatory, <http://co2now.org>.

References

- ABB. n.d. 'Energy Efficiency Performance in Power Generation,' ABB Power and Productivity for a Better World. www.abb.com/product.
- Areeparampil, M. 1996. 'Displacement due to Mining in Jharkhand,' *Economic and Political Weekly*, 31(24). 15 June.
- Bairiganjan, S., Ray Cheung, Ella Aglipay Delio, David Fuente, Saurabh Lall, and Santosh Singh. 2010. *Power to the People: Investing in Clean Energy for the Base of the Pyramid in India*. Chennai and Washington, D.C.: Centre for Development Finance and World Resources Institute. Available at http://pdf.wri.org/power_to_the_people.pdf.
- Bhanumathi, K. n.d. 'Status of Women Affected by Mining in India,' Report of Mines, Minerals and People. Available at <http://www.samataindia.org/documents/Status%20of%20Women%20Affected%20by%20Mining%20in%20India.PDF>.
- Blacksmith Institute. n.d. 'Panki Katra Fly-ash Contamination,' Blacksmith Institute, www.blacksmithinstitute.org.
- BP. 2007. *Statistical Review of Energy, 2007*. London.

- . 2012. *Energy Outlook 2030*. London.
- CDM Watch. 2010. Newsletter No.5, Sept. 2010, www.cdm-watch.org.
- CGES. 2011. 'India's Demand for Oil Increases,' Centre for Global Energy Studies, Jan. 2011. Available at <http://www.cges.co.uk/resources/articles/2011/01/18/india-s-demand-for-oil-increases>.
- CIA. n.d. *The World Factbook*. Central Intelligence Agency. www.cia.gov.
- DNA. 2011. 'Higher Wage Cost Forces Coal India to Hike Prices By 30%,' *Daily News and Analysis*, 28 February.
- Down to Earth*. 2011. 'Environment Ministry Creates a Record in Forestland Diversion'—Chapter 1 Overview, 22 September, *Down to Earth*. Available at www.downtoearth.org.in.
- Dutt, K.L., Radhika Krishnan and Nesar Ahmad. 2012. 'Land Acquisition and Dispossession: Private Coal Companies in Jharkhand,' *Economic and Political Weekly*, 47(6): 39–45.
- Economic Times*. 2011. 'Indonesian Coal Price Hike Sings Indian Power Companies,' *Economic Times*, 3 October.
- EIA. 2010. *International Energy Statistics 2010*. U.S. Energy Information Administration, www.eia.gov.
- EPA. n.d. 'Radiation Protection: Coal Ash,' U.S. Environment Protection Agency, www.epa.gov/radiation/tenorm/coalandcoalandash.
- Gee, E.R. 1940. 'History of Coal Mining in India,' Geological Survey of India. August. Available at http://202.41.82.144/rawdataupload/upload/insa/INSA_1/20005b80_313.pdf.
- GENI. 2010. Overview of Sustainable Renewable Energy Potential of India. San Diego, California: Global Energy Network Institute.
- Greenpeace and European Renewable Energy Council (EREC). 2010. 'Energy (R) evolution—A Sustainable Global Energy Outlook 2010,' Greenpeace and European Renewable Energy Council. Available at <http://www.greenpeace.org/international/Global/international/publications/climate/2010/fullreport.pdf>.
- GoD. 2009. *Economic Survey of Delhi 2008–9*. Chapter on 'Energy'.
- . 2010. *Economic Survey of Delhi 2009–10*. Chapter on 'Energy'. http://delhi.gov.in/wps/wcm/connect/DoIT_Planning/planning/our+services/economic+survey+of+delhi.
- GSi. n.d. 'Coal,' Geological Survey of India, www.portal.gsi.gov.in, accessed March 2012.
- Hansen, James et al. 2007. 'Climate Change and Trace Gases, Fossil Fuel Reservoirs.' Available at <http://www.planetwork.net/climate/Hansen2007.pdf>.
- Hansen, James, Makiko Sato, Pushker Kharecha, David Beerling, Valerie Masson-Delmotte, Mark Pagani, Maureen Raymo, Dana L. Royer and James C. Zachos. 2008. 'Targeting Atmospheric CO₂: Where Should Humanity Aim.' New York: NASA/GISS. Also available at http://www.columbia.edu/~jeh1/2008/TargetCO2_20080407.pdf.

- Hvistendahl, M. 2007. 'Coal Ash is More Radioactive than Nuclear Waste,' *Scientific American*, 13 December.
- IEA. 2009. *World Energy Outlook 2009*. Paris: International Energy Agency. www.iea.org.
- . 2010. *Key World Energy Statistics 2010*. Paris: International Energy Agency. www.iea.org.
- . 2011. *World Energy Outlook 2011*. Paris: International Energy Agency. www.iea.org.
- Indian Power Sector. n.d. 'History of Indian Power sector,' <http://indianpowersector.com>.
- IPCC. 2007. 'Climate Change 2007: The Physical Science Basis,' IPCC Fourth Assessment Report, www.ipcc.ch/publications_and_data.
- IRINnews. 2012. 'Global: Twelve Countries on Climate Change Hit List,' *IRINnews*, February.
- Kothari, Smitu. 1995. 'Development, Displacement and Official Policies: A Critical Review,' *Lokayan Bulletin*, March-April, No. 11.5. New Delhi.
- Krishnaswami, S. 2010. *Shifting of Goalposts: Rural Electrification in India—A Progress Report*. Delhi: Vasudha Foundation.
- MoC. 2010. 'All India Overall Coal Demand (BE) & Supply — Sectorwise: 2009–10,' Provisional Coal Statistics 2009–10. Kolkata: Coal Controller's Organisation, Ministry of Coal, Government of India.
- MoP. 2011. 'Power Sector at a Glance – ALL INDIA,' Ministry of Power, GoI, www.powermin.nic.in.
- MoP&NG. 2011. *Basic Statistics on Indian Petroleum and Natural Gas 2010–11*. Ministry of Petroleum and Natural Gas, Government of India. <http://petroleum.nic.in>.
- NCEUS. 2007. *Conditions of Work and Promotion of Livelihood in the Unorganised Sector*. New Delhi: NCEUS.
- NCW. n.d. 'Development Induced Displacement of Women,' a report by the National Commission for Women. available at <http://ncw.nic.in/pdfreports/Development%20Induced%20Displacement%20of%20Women.pdf>.
- Planning Commission. n.d. 'Power and Energy,' Steering Committee Working Group on Eleventh Plan, Planning Commission. <http://planningcommission.nic.in/sectors/index.php?sectors=energy>.
- Sierra Club India. 2011. 'Coal is Cheap? World's Largest Coal Plants Bankrupted by Skyrocketing Prices,' Sierra Club, <http://sierraclub.typepad.com/compass/2011/08/sierra-club-india-coal-is-cheap.html>.
- WCA. 2010. 'Where Is Coal Found?' World Coal Association. www.worldcoal.org.
- World Coal Institute. 2005. *The Coal Resource—A Comprehensive Overview of Coal*. London: World Coal Institute.

The Emerging Climate Change Crisis and the Response of the State in India

Soumya Dutta

A2.1 Introduction

As we saw in the earlier sections, India is one of the most vulnerable countries in regard to several catastrophic impacts of climate change.¹ India's water resources, biodiversity, coastal ecosystems, mountain ecosystems and agriculture are particularly susceptible to climate change (MoEF 2010). The severest impacts are likely to be on:

- India's large majority of small-holders and peasant farmers who practice low-input, rain-fed farming. These persons have little financial or material resources to cope with the increased risk, uncertainty and losses that will occur from monsoon changes, increases in night temperatures during growing seasons, fewer but more intense rainfall days and increases in drought incidence (Sharma 2008).
- The large populations living and managing livelihoods in river basins, due to increased flooding and a fall in lean season flows (Diagle 2010).

- Coastal communities, due to the multiple impacts of sea-level rise, such as ground water and soil salinization, reduction in fish catch and so on.²
- Himalayan ecosystems and communities, due to drastic changes in seasonal water availability, snow and ice cover, as well as changes in temperature-humidity regimes that would render many areas unsuitable for both staple and cash crops.³

Even though India's forests are not seen facing as great a threat (in terms of total forest biomass) as the above ecosystems from climate change, several areas are reporting increased forest fires, and as a result of the dangers to forest biodiversity, the livelihoods of forest-dwellers and forest fringe villages are also increasingly under threat. As per one study, 'In India nearly 200,000 villages are located in or near forests, and depend heavily on forest resources for their livelihood activities. Industry is also a factor, as industry depends on forests for raw materials. Climate change is likely to impact forest biodiversity through changing biome types and shifting forest boundaries. This will in turn impact the supply of forest products, as well as the livelihoods of forest dependent communities, who use forest resources for fuelwood, building materials, and incomes through the sale of forest products.'⁴ In addition, many of the policies and plans that are made in the name of saving the forests themselves have negative impacts on forest dependent communities; these are discussed in more detail below.

Many of these adverse impacts are already underway several parts of the country, as reports over the last few years show. The numbers affected rise with every year, and for natural resource-based poor communities, the situation is slowly assuming crisis proportions. Facing such a threat to its people, any government—particularly in a democratic system—is required to act quickly and decisively, with the aim of ensuring the maximum security for the maximum number of its people. India is said to be the 'largest democracy' in the world, and this would necessitate an inclusive, just and equitable response from

the State to the challenge of climate change, keeping the interests of the most vulnerable as the top priority.

In this theme paper, we will try to examine briefly the responses of the Indian state, and how they fare with respect to these yardsticks. The main document has dealt with international climate politics and India's role in it. Here, we will concentrate on its domestic policies, plans and actions.

A2.2 Climate Change Policies and Plans in India

Following up on its international commitments and positioning in climate negotiations, the Government of India released its National Action Plan on Climate Change⁵ (NAPCC) in June 2008. A small group of 'experts and advisers,' from the Prime Minister's Council on Climate Change, prepared the plan in an opaque and non-participatory manner. Sector specific 'stake-holders' were simply never consulted. The resulting 49 page 'Action Plan' neither had any quantitative targets for any of the areas covered, nor any target dates by which concrete goals would be achieved. This is in sharp contrast to China's climate action plan,⁶ unveiled in June 2007, where both quantitative targets and target dates were specified—spurring rapid action on the renewable energy front. In India's NAPCC, all these were left to be worked out in the mission documents. The NAPCC describes these missions as follows: 'There are eight National Missions which form the core of the National Action Plan, representing multi-pronged, long-term and integrated strategies for achieving key goals in the context of climate change.' These are:

1. The Jawaharlal Nehru National Solar Mission;
2. Mission for Enhanced Energy Efficiency;
3. Mission on Sustainable Habitat;
4. National Water Mission;
5. Mission for Sustaining the Himalayan Ecosystem;
6. Mission for a Green India;

7. Mission for Sustainable Agriculture; and
8. Mission on Strategic Knowledge for Climate Change.

Surprisingly, with a coastline in excess of 7500 kilometres and nearly 20 percent of India's population living in or dependent on this area, there is no mission for the coasts. This is even more callous as the coasts are among the most vulnerable areas to climate change, as the government itself says, and as several reports have highlighted.⁷ With such a large number of people vulnerable to climate change impacts, it would also be normal to expect the government to be proactive on adaptation measures, but that is sadly lacking.

One major problem of the NAPCC, to begin with, is the lack of public consultations and transparency involved in preparing a multi-dimensional plan for a diverse country of over 1200 million people. Secondly, as the CPR Environment Education Centre of the Ministry of Environment and Forests has said: 'The country has 10 different bio-geographic zones and 26 biotic provinces' (Rodgers et al. 2000). These are:

S.No.	Bio-geographic zones	Biotic provinces
1.	Trans-Himalaya	Ladakh mountains, Tibetan plateau
2.	Himalaya	Northwest, West, Central and East Himalayas
3.	Desert	Thar, Kutch
4.	Semi-arid	Punjab plains, Gujarat, Rajputana
5.	Western Ghats	Malabar plains, Western Ghats
6.	Deccan Peninsula	Central highlands, Chotta-Nagpur, Eastern highlands, Central Plateau, Deccan South
7.	Gangetic plains	Upper and Lower Gangetic plains
8.	Coast	West and East coast, Lakshadweep
9.	North-East	Brahmaputra valley, Northeast hills
10.	Islands	Andaman and Nicobar

The Centre goes on to say that these areas have '*immense diversities of physical/climatic, biological, agricultural and other natures.*' Yet, a 'national action plan' was unveiled, without any significant studies on actual climate change impacts being conducted, and without any effort to study how these various eco-systems and their inhabitants are

responding to these impacts.⁸ A few ‘wise men’ of the Prime Minister’s Council on Climate Change appear to have prescribed all the solutions for all of India’s diverse situations and problems.

Well researched critiques of the NAPCC include one prepared by Himanshu Thakkar (2009) of the South Asia Network of Dams, Rivers and People (SANDRP), as well as another paper, titled ‘NAPCC-India: Climate Change, Gender and Innovation’ (Apparusu 2011) which points out the lack of gender perspectives in the NAPCC, and suggests ways of integrating gender in various sectoral plans. A third review of India’s climate action plan, by the Odisha-based Regional Centre for Development Cooperation (Whitley 2011), is quoted below:

- It relies too much on out of date IPCC projections and not the best currently available climate science, thereby leading to a lack of urgency.
- Lack of clarity with regards to roles and responsibilities. How is the NAPCC to reach citizens all over India? There is no definitive strategy on how to roll out the eight Missions on the ground.
- There is an overall vagueness to the NAPCC—for example it hints at ‘qualitative change in a direction that enhances ecological sustainability’ but essentially does not identify how this would be achieved.
- It does say: ‘India is determined that its per capita greenhouse gas emissions will at no point exceed that of developed countries even as we pursue our development goals’—if it ever does reach that limit, it would be an awful state of affairs anyway, so this is not a desirable target. The per capita equity approach is potentially very dangerous.

Also, there so far appears to be a distinct inconsistency between green rhetoric and practice. For example, it refers to the protection of biodiversity, yet there are proposed government projects (such as big dams) that directly threaten bio-diverse regions, not to mention allowing developments like the Orissa POSCO mine to go ahead.

The time left for taking meaningful actions is running out, as the missions are initially supposed to give directions for programmes until the end of the Twelfth Five Year Plan, i.e., until 2017.

The climate change clock will not stop ticking on account of India's non-action.

Next, this paper will look briefly at the dominant policy regime (for a few climate sensitive sectors) of the Indian state, and see how these are inconsistent with and often contradictory to the supposed climate mitigation and adaptation objectives of the eight 'Missions' under the NAPCC, before brief exploring some of the State Action Plans on Climate Change (SAPCCs).¹⁰

Domestic Growth Model Contradicts Climate Change Concerns

The dominant domestic policies and actions of the Indian state are far from consistent with what is required to proactively tackle climate change. India has rightly continued to blame the rich nations for causing the crisis in the first place, as a result of their high energy and material resource consumption as well as high carbon emission economic pathway. But it too has blindly adopted the same energy and carbon-intensive economic growth-centric 'development' model, particularly after the liberalization-privatization-globalization agenda took over in the early 1990s. Thus, the NAPCC begin by stating:

India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change. This threat emanates from accumulated greenhouse gas emissions in the atmosphere, anthropogenically generated through long-term and intensive industrial growth and high consumption lifestyles in developed countries. (GoI n.d.)

Yet, at the same time, Indian policies promote the same climate-threatening 'intensive industrial growth and high consumption lifestyles.' While moving to a safer future climate regime will demand moving away from carbon-intensive and otherwise highly polluting energy sources, from the early days in the mid-1990s, India's consumption of coal (the most climate and health damaging fuel) nearly doubled (GoI 2008), and its fossil fuel-based power capacity more than doubled.¹⁰ The rate of destruction of its forests, for extraction of

coal and other mineral resources, has increased by nearly 250 percent (forest diversion during Eighth Five Year Plan 1992–97 was about 84,587 hectare, while that during the Eleventh Five Year Plan 2007–2012 was over 204,400 hectare) (*Down to Earth* 2011).

All these processes took place despite the NAPCC admitting that ‘climate change may alter the distribution and quality of India’s natural resources and adversely affect the livelihood of its people. With an economy closely tied to its natural resource base and climate-sensitive sectors such as agriculture, water and forestry, India may face a major threat because of the projected changes in climate.’ This is said as if all the qualitative (and quantitative) degradation of our natural resource, as a result of rampant large-scale mining, industrialization, urbanization and dirty power projects, will not affect its poor people dependent on the ‘climate sensitive sectors.’

On top of these, government policies directly promote increased consumption of highly energy-intensive materials such as aluminium and steel, in place of environment-friendly and livelihood-supporting materials such as wood, cane, bamboo and a variety of reeds and grass. This contributes significantly to global warming, as well as to forest destruction by mining and large-scale water pollution, while increasing the profits of mega corporations. Aluminium production has gone up from well below one million tonnes to nearly two million tonnes; aluminium is the most energy and emission-intensive common material in use, with well over 20 kilograms of carbon dioxide emission for every kilogram produced.¹¹ Steel production has risen from a little over 20 million tonnes in 1995 to about 65 million tonnes in 2010.¹² An increasing percentage of the nation’s scarce water resources is being allotted to the heavily polluting big industries and thermal power plants, at the expense of starving agriculture of this life sustaining resource.

Climate Friendly Agriculture Throttled

India has a large percentage of its people dependent on climate-vulnerable agriculture; about 60 percent of Indians are almost totally dependent on agriculture, with nearly 50 percent of the

workforce involved in it.¹³ Yet, this vital food producing sector has been neglected, and its share in GDP has continuously come down (at factor cost) from about 21 percent in 2004–05 to less than 15 percent in 2011 (GoI 2011). If we take a look at the core plant-based food growing agriculture and separate the livestock sector, an even more alarming picture emerges, with such agriculture producing a meagre 11 percent of GDP in 2010–11 (*ibid*). It bears noting that most of the poorer peasant farmers and agricultural workers depend on such agriculture for survival; further, it is both climate-sensitive and a good carbon sink. At the same time, the cost of external inputs to agriculture (chemical fertilizers and pesticides, diesel oil, seeds, etc.) has consistently risen, at a much faster rate than agricultural income (*ibid*).

This overall decline is not an economy-wide phenomenon; it is confined to agriculture, and it is also unrelated to the recent global economic crisis (2008–11) (CSO 2011b). In the same years of 2008–9 and 2009–10, when carbon-sequestering agriculture (that is, agriculture excluding livestock) and its major products experienced negative growth rates, emissions-intensive mining (mostly coal and iron ore), apparels, chemicals, metal products, machinery, telecommunications, electrical machinery, transport equipments, automobiles and other such sectors all experienced ‘healthy’ growth (*ibid*). In terms of climate change-inducing GHG emissions, the percentage share of agriculture in India’s total carbon dioxide emission came down from 25.6 percent in 1995 to about 17 percent in 2008–9, while the electricity and heat sector has jumped from 30 percent to 56.3 percent, with the manufacturing and construction sector going up from 13.6 percent to 18.5 percent.¹⁴ Even the absolute growth in emission from agriculture in this period is very low, while it successfully fed over 30 percent more people in 2010 than in 1995,¹⁵ and in spite of substantial growth in total economy-wide emissions. Thus, agriculture in India contributed to contain India’s GHG emissions growth, but has been made to suffer badly, while sectors that contributed to increased emissions have been encouraged and incentivized. A prudent climate change policy direction indeed!

This extreme crisis explains India's position at the 67th slot in the Global Hunger Index (IFPRI 2010), and the fact that its hunger status remained at 'alarming' throughout the last decade (*ibid*). The state of India's agriculture thus becomes clear and the 'India Growth Story' that we sell to the world, gets exposed for what it is—loot and exploitation of both nature and poorer communities by an increasingly greedy and wealthier minority. These phenomena have resulted in extreme distress in farming communities, resulting in over 150,000 farmer's suicides in the last 15 years (Sainath 2011) along with many reports of starvation deaths. These communities' pauperization has greatly increased vulnerability to impacts of climate change. It is important to note that vulnerability is a composite function of the risk or hazards people face and of their coping capacities (SOPAC 2004), and by reducing the coping capacities of the vast majority of our poor, at a time of increased risks from climate change (and other threats), the government is essentially writing post-dated death sentences.

How does the National Mission on Sustainable Agriculture (NMSA)¹⁶ propose to prepare India for such enormous challenges? The NAPCC has identified the following focus areas for the Mission:

1. Dry-land agriculture;
2. Risk management;
3. Access to information;
4. Use of biotechnology.

These are combined with several apparently 'right' ideas, such as 'mapping of risks with adaptation and mitigation needs which clearly distinguishes short-term and long-term requirements; development of drought and pest-resistant crop varieties; improving methods to conserve soil and water to ensure their optimal utilization. Generate awareness through stakeholder consultations, training workshops and demonstration exercises for farming communities, for agro-climatic information sharing and dissemination. Financial support to enable farmers to invest in and adopt relevant technologies to overcome climate related stresses.'

The plan goes on to stress potentially hazardous and untested biotechnology focus areas:

Priority Areas are I. Genetic engineering to convert C-3 crops to the more carbon responsive C-4 crops to achieve greater photosynthetic efficiency for obtaining increased productivity at higher levels of carbon dioxide in the atmosphere and to sustain thermal stresses. II. Development of strategies for low input sustainable agriculture by producing crops with enhanced water and nitrogen use efficiency which may also result in reduced emissions of greenhouse gases, and crops with greater tolerance to drought, high temperature, submergence and salinity stresses.

The push for ‘technological solutions’—not only GM crops, but also GM animals—is clear in the action points of the mission:

Use of Bio-technology — I. Develop transgenic crops with inbuilt resistance to drought and heat stresses. II. Genetic engineering for developing genotypes (livestock, fish, poultry and microbes) resistant to high temperature and drought stress. III. To produce transgenic plants with enhanced capacity for carbon dioxide fixation, which in turn can result in producing high biomass and increased productivity. The use of plant biotechnology is expected to increase the productivity of land already cultivated, reduce the need to cover additional land and thus contribute to conservation of biodiversity.

This approach is fraught with the danger of genetic contamination of native varieties, and resultant loss of potentially useful genetic biodiversity, at a time of climate risks—when such diversity is critically needed for coping strategies. This also carries high risk of farmers losing control over their crops to monopolization by a handful of biotechnology companies, as has already happened with the cotton crop, with genetically modified Bt cotton now constituting over 90 percent of all cotton grown in India (Choudhary and Gaur 2010); indigenous varieties with unique biological traits are becoming difficult to find, and cotton farmers are forced to shell out yet more money for proprietary seeds. But even aside from these threats, to tackle the large array of climate change responses that the plan

proposes, the government and its agencies must be preparing to invest massively in all these measures. A cursory look at government expenditure show that in reality, public investment in agriculture actually came down from around 2.1 percent of GDP in 1990–91 to about 1.8 percent of GDP in 2010–11. Even after the NAPCC came into being, this vitally needed investment has decreased in every year from 2008–09 to 2010–11 (MoF 2011). Without adequate support, farmers will be left to tackle climate risks on their own, in addition to the general crisis that is already affecting their livelihoods.

The Water Mission: Making Way for More Disasters

The Water Mission, the ‘comprehensive mission document’ of the National Water Mission¹⁷ was unveiled in April 2009 and is the government’s plan to tackle the massive disruptions of our water resources expected as a result of climate change. The government’s ‘Initial National Communication to the United Nations Framework Convention on Climate Change,’ published by the Ministry of Environment and Forests, points to the following impacts of climate change on India’s water resources:¹⁸

It is obvious that the projected climate change resulting in warming, sea level rise and melting of glaciers will adversely affect the water balance in different parts of India and quality of ground water along the coastal plains. Climate change is likely to affect ground water due to changes in precipitation and evapo-transpiration. Rising sea levels may lead to increased saline intrusion into coastal and island aquifers, while increased frequency and severity of floods may affect groundwater quality in alluvial aquifers. Increased rainfall intensity may lead to higher runoff and possibly reduced recharge.

Many of these impacts are already visible. Despite this, large numbers of high-emission, particulate-spewing industries like cement plants are being encouraged in the Himalayan States;¹⁹ the dark particle emissions (aerosols) from such industries cause snow and ice to become darker and melt away faster,²⁰ exacerbating the effect of

warming. The explosive rise of small diesel vehicle use in hill towns adds additional amounts of dark aerosols.

Meanwhile, the government is seeking to create many new big dams in the Himalayas²¹ in the name of climate change response, in the name of ‘creating more storage’ in order to counter diminishing snow and ice. These dams will have multiple adverse impacts, in addition to the usual displacement and loss of livelihoods. The world’s largest deltaic area,²² stretching over 105,000 square kilometres, has been created by the silt and sediments (*Environmental Geology* 1997)—over one billion tonnes a year—carried by the Ganges-Brahmaputra river system in India-Bangladesh (Kuehl et al. 2005). But there are now plans for over 350 big dams on these rivers, which will cut off this silt supply, adding to the net coastal land loss. In addition, the large number of reservoirs in these cold areas will push temperatures up further, as water is a very good heat absorber. This will put additional stress on snow and ice cover. If created, these reservoirs will add large quantities of two greenhouse gases—evaporated water vapour and methane from rotting vegetation underwater—into the atmosphere of this sensitive region, creating further warming potential. These in turn will reduce water availability even more, leading to a classic case of a positive feedback loop.²³ This vicious cycle would be the sole result of a ‘climate change policy response.’

The mission document²⁴ highlights:

The five identified goals of the Mission are: (a) comprehensive water data base in public domain and assessment of impact of climate change on water resource; (b) promotion of citizen and state action for water conservation, augmentation and preservation; (c) focused attention to over-exploited areas; (d) increasing water use efficiency by 20%, and (e) promotion of basin level integrated water resources management.

While acknowledging that ground water resources in the north-western part of India are already overstressed, the policies encourage increasing ‘mining’ of ground water (water mining is the term used when extraction exceeds recharge). As Himanshu Thakkar (2009) points out in his critique of the NAPCC, ‘The real water lifeline of

India is groundwater. Over two-thirds of the foodgrains production coming from irrigated lands is contributed by lands irrigated by groundwater. Over 85% of rural and over 50% of urban and industrial water supply comes from groundwater sources.' A recent study by the Goddard Space Flight Centre (Rodell et al. 2009), using NASA's GRACE satellites, showed a net loss of around 109 billion cubic metres of groundwater from a region encompassing parts of Punjab, Haryana, Rajasthan and Delhi, all in a short period between 2002 and 2008. This loss is particularly alarming, as rainfall in these areas was slightly above normal during the period under study. Despite such findings, the government has neither tried to create a 'comprehensive water data base in the public domain,' nor has it done any serious 'assessment of impact of climate change,' and the random over exploitation continues. To quote from the *Nature* article: 'If measures are not taken soon to ensure sustainable groundwater usage, the consequences for the 114,000,000 residents of the region may include a reduction of agricultural output and shortages of potable water, leading to extensive socio-economic stresses' (Altaf 2011).

Instead of encouraging planned and distributed water harvesting through 'promotion of citizen and state action,' the focus on big storage projects can only increase distress, while ensuring profit for the construction-steel-cement lobbies. Yet the flawed NWM adopts precisely this focus; it includes among its strategic objectives the following statement: 'Expeditious implementation of water resources projects, particularly the multipurpose projects with carry over storages.' In addition, it reflects clear designs to promote high-cost corporate 'packaged solutions,' including handing over this precious public resource to profit-hungry private companies, when it advocates 'Promotion of water purification and desalination techniques... Research for development of cost effective water purification and desalination technologies... Encourage PPP model for desalination—preparation of necessary guidelines...'

Rapid urbanization, which is also a stated goal of government policy, is also driving water-intensive lifestyles and industries, instead of 'increasing water use efficiency by 20%.' This is accompanied by

large-scale concretization of and construction on flood-plains of rivers, leaving little space for ground water recharge, even at times of good rainfall.

The Energy Mission: Creating Business Opportunities for Large Corporations

The solar mission,²⁵ which has been titled the Jawaharlal Nehru National Solar Mission, is one of the two missions on energy. It supposedly aims to take India away from dependence on dirty energy. In the first few paragraphs of the mission document, the Prime Minister of India is quoted:

Our vision is to make India's economic development energy-efficient. Over a period of time, we must pioneer a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable sources of energy. In this strategy, the sun occupies centre-stage, as it should, being literally the original source of all energy. We will pool our scientific, technical and managerial talents, with sufficient financial resources, to develop solar energy as a source of abundant energy to power our economy and to transform the lives of our people.

The JNNSM has had some successes. It has been able to launch the first phase of a solar grid-connected electricity programme in the country. Around 530 MW of solar power projects achieved financial closure in July 2011,²⁶ with the bulk of these being concentrated solar thermal power plants. This is despite the problems of corporate crony-capitalism and corruption that have plagued the Mission.

However, a deeper problem with this centralized approach is that it is counterproductive to put the expensive power generated by a distributed and 'low-energy density' source such as solar into a national or regional grid. But the dubious intentions and indifferent approach of policymakers are exposed when one notes that the government simultaneously gave clearance to over 200,000 MW of coal-based thermal power plants in the Eleventh Five Year Plan alone (see Annexure 1). This does not mark 'a graduated shift away from... fossil

fuels,' but a very tight embrace of this dirty energy, for a long time to come; by which time it might be too late to prevent catastrophic effects of climate change. For all the talk of pooling scientific, technical and financial resources, the government gave only ₹1000 crore to the Department of New and Renewable Energy in the 2010–11 budget, and just ₹1200 crore in 2011–12²⁷—for the purpose of supporting all kinds of renewable energy research, development, institution building and incentives. In the same period, the Department of Atomic Energy—which has managed to set up only 4780 MW of installed nuclear power after 43 years of operations²⁸—has been allocated a budget estimate of over ₹8200 crore in 2010–11, which went up to over ₹10,000 crore in 2011–12 (*Economic Times* 2011b). With this puny budgetary support, it needs to be appreciated that the total renewable installed capacity at the time of writing (February 2012) is over 22,000 MW,²⁹ most of which originates in wind power.

Meanwhile, in yet another example of its true priorities, the government's Integrated Energy Policy³⁰ unrealistically and illogically fixes a target of 63,000 MW installed capacity for nuclear power by 2032, while renewable sources are projected in a poor light. The policy claims that, 'with a concerted push and a 40-fold increase in their contribution to primary energy, renewables may account for only 5 to 6% of India's energy mix by 2031–32.' Consumption of coal, the dirtiest of all fuels, is projected to go up to over two billion tonnes from today's ~640 million tonnes. To aim for only 5–6 percent of a total installed capacity of 800,000 MW (that is, 40–48,000 MW) from all renewable sources by 2032 is clearly not an ambitious target. This can be compared to China's annual addition of 30–35,000 MW of renewable capacity.

The Enhanced Energy Efficiency mission³¹ has a number of welcome measures to incentivize purchase of more efficient products, through labelling, tax cuts and public procurement policies. But the EEE mission is mainly focused on creating more market opportunities, and this is revealed in its opening:

Perform Achieve and Trade (PAT): The Perform Achieve and Trade scheme is a market-based mechanism to enhance energy efficiency in the 'Designated Consumers' (large energy-intensive industries and facilities).

This market opportunity push is present even in the energy efficient appliances programme, in the form of promoting CDM:

The initiative includes the following activities: National CDM Roadmap. Programmatic CDM: BEE is exploring undertaking CDM Programme of Activities for the following sectors: lighting (Bachat Lamp Yojana), Municipal DSM, Agricultural DSM, SME sector, Commercial Building sector and for Distribution Transformers.

With the scam-ridden, topsy-turvy CDM (NFFPFW et al. 2011) carbon market in a tailspin for the last few years, what will happen to these CDM-linked efficiency programmes can be imagined.

Green India Mission: REDD+ by Another Name³²

This mission is the only one out of the eight for which several public consultations were held. These were, however, held only in seven major regional cities, while the subject matter of this mission concerns forest dwellers and forest dependent people. Put in the public domain in May 2010, the mission document was also translated into several languages for more effective consultation, and inputs were sought from a larger number of stakeholders, including Gram Panchayats. The Mission also contains several apparently correct provisions, including a focus on forest rights, local democratic institutions (Gram Sabhas and Panchayats) and so on.

Despite this, the essentially dubious character of the Green Mission is best revealed in the proposal for 'creating a new cadre of community youth as foresters,' and the insistence on Joint Forest Management. As discussed in the chapter on mitigation, both of these suggest a central role for the coercive forest bureaucracy of the country, while simultaneously undermining the Forest Rights Act, which provides for an hitherto unheard of degree of community control in government-held forests. There are other dangerous strategies, such as involving the 'private sector, especially in agro forestry, institutional lands, abandoned mines...', and the creation of a 'REDD Plus cell,' all of which seriously undermine and challenge community rights in

forests. This is particularly the case with the plans and actions on REDD+, as these make way for wholesale commoditization of Indian forests (MoEF 2011). Marketing forest services including carbon also finds prominent place in most of the State Action Plans.

A2.3 State Action Plans on Climate Change³³

The national capital, Delhi, was the first State to roll out its SAPCC³⁴ in November 2009, following the central directive for all States to prepare their State Action Plans, *'keeping in view the National Action Plan on Climate Change.'* The State Plans have continued the trend of not consulting the public at large and preparing the plan inside the government machinery.

Another common feature is visible in the effort to showcase earlier, unrelated programmes as climate change actions, instead of looking at the problem of climate change holistically. In 1998, the Supreme Court had directed the Delhi government to switch its public transport system to compressed natural gas (CNG) and had set a deadline of April 2001 for this to be completed. The transition finally took place in December 2002, after repeated strictures by the Court.³⁵ Despite this reality, the SAPCC of Delhi, formulated in November 2009, claims credit for this move. Similarly, natural gas-based power generation in Delhi are also listed in the SAPCC, though both the gas turbine power stations in Delhi were established before 2004 (Pal et al. 2009). These, no doubt, are meaningful actions, along with Delhi's urban forest creation and schemes to encourage solar water heating systems in all public buildings, but none of these were specifically intended for the SAPCC, and all are pre-SAPCC in origin. Since the 'launch' of the plan, Delhi's power consumption has shot up—mostly derived from coal-based power plants from elsewhere in the country.³⁶ Water wastage/leakage continues at an astonishingly high 40 percent of total supply,³⁷ and the city did nothing to curb the explosive growth of bigger private vehicles. Rather, it has encouraged such vehicles by making more road space available for them, at the expense of public buses.

Until last count, about 18 States have reached the 'submitted draft' stage for their SAPCCs (Ghosh and Chandran 2009). A few have gone in for very limited consultation before coming out with a draft, such as Assam in the northeast, which held three consultation in three universities in the State, and formulated the plan after collecting information and recommendations from these. While the Indian people have been largely excluded from the process of formulating these SAPCCs, the process in many States smacks of being driven by foreign donors' money.³⁸

There is a clear bias, or even an explicit push, in these plans in favour of large-scale industrial projects and so-called 'high-technology' approaches. For example, a hilly and forested remote State like Manipur is proposing to have LEED certified buildings and low-carbon expressways in its SAPCC. The German agency GTZ and a private firm, International Resources Group Systems South Asia Private Limited (IRGSSA), were involved in its formulation, and their desire to open more avenues for private profit is clearly visible. Similarly, the Nagaland SAPCC also involved private environmental consultants, but the government refused to hold large-scale public consultations on it. Environmental and human rights groups in Manipur (*Huaiyen Lanpao* 2011) persuaded the government to open up slightly and conduct a few public consultations—at the district level and at universities. In the States of Madhya Pradesh, Uttarakhand and Karnataka, events took a similar turn. By and large, however, most SAPCCs were never opened to other stake-holders, though they all talk of 'engaging stake-holders,' and of following the UNDP methodology for such engagement.

Another key trend emerges with respect to forests. Every State with any significant amount of forest area makes repeated references to forest carbon stock, because of the possibilities of earning money from these through the REDD+ scheme.³⁹ The adverse impacts this will have on the forest dependent communities in these States is never mentioned (Durban Coalition for Climate Justice 2011). Many SAPCCs refer to agro-fuel and biofuel plantations (*Econexus* 2011), notwithstanding such plantations' detrimental effect on biodiversity

and food security. Also common is an emphasis on so-called public-private partnerships.

While the NAPCC did not have a coastal mission, most coastal States have included a sectoral plan for their coastal zones. These are, however, being driven yet again by the privatization approach or the desire to create new profit opportunities. This is the case in Odisha, Gujarat and West Bengal, where the World Bank dictated and funded Integrated Coastal Zone Management Plan⁴⁰ is operational. The Asian Development Bank funds less comprehensive Shoreline Management Projects in Karnataka, Maharashtra and Goa; these projects now talk of drawing a 'vulnerability line,' causing panic among traditional coast dwellers (mostly fisherfolk) about possible forced displacement in the name of vulnerability, while no such bar is enforced on coastal power plants and major new ports (many of which are privately owned and promoted).

Thus, instead of generating confidence among the larger and more climate-vulnerable sections of India's vast population, the national and State action plans on climate change only reinforce the feeling that the business and political classes are seeking to gain out of these emerging crises by offering the nation's poor and deprived up as bait.

Notes

1. *IRINnews* (2009), based on the World Bank study of 12 most vulnerable countries to climate change.
2. See 'Climate Change Impacts on Sea Levels in India,' www.decc.gov.uk; also see 'Impact on River Deltas and Other Coastal Areas,' www.indiawaterportal.org.
3. 'Climate Change and Himalayan Ecosystem,' Climate Change Community/Solution Exchange (initiative of UN country team in India), www.hpenvis.nic.in.
4. 'Climate Change Impacts on Forestry in India,' www.decc.gov.uk.
5. 'National Action Plan on Climate Change,' available at india.gov.in/allimpfrms/alldocs/15651.doc.
6. 'National Climate Change Program' unveiled by the National Development and Reform Commission of China and available at www.china.org.cn.

7. NAPCC, *op cit.* See <http://envfor.nic.in/cc/adaptation/coastal.htm>. Also see www.cansouthasia.net.
8. 'Prime Minister's Council on Climate Change,' available at www.cfr.org/india/indias-council-climate-change.
9. Available at <http://envfor.nic.in>.
10. See CSO (2011a); also see Central Electricity Authority at www.ce.nic.in.
11. See www.equitymaster.com and www.metalworld.co.in for more details.
12. See International Aluminium Institute, www.world-aluminium.org, www.calsmelt.com/energy-environmental, for more.
13. 'Development of Indian Steel Sector Since 1991,' Ministry of Steel, Government of India, available at <http://steel.nic.in/development>. Also see 'India Economy 2012,' available at www.theodora.com/wfbccurrent/india and also <http://india.gov.in/sectors/agriculture>.
14. Sectoral emission data series, World Resources Institute, www.wri.org. India's initial communication to the UNFCCC puts agriculture's share of total CO₂e emission—mostly methane and nitrous oxide—at around 31 percent in 1994.
15. Growth of population in this period, from the Census of India.
16. National Mission for Sustainable Agriculture, available at <http://moef.nic.in/downloads/others/Mission-SAPCC-NMA>.
17. National Water Mission, Ministry of Water Resources, Government of India. Available at <http://india.gov.in/allimpfrms/alldocs/15658>.
18. India's Initial National Communication to the United Nations Framework Convention on Climate Change, 2004, Ministry of Environment and Forests, Government of India. Available at <http://unfccc.int/resource/docs/natc/indnc1.pdf>.
19. Jaypee Group's Cement Plant, Ambuja Cements in Solan district, ACC's Gagal cement plant in Bilaspur district, the proposed Lafarge cement plant and so on. (Sood 2008).
20. Black Carbon Research Initiative, National Carbonaceous Aerosol Programme (NCAP) Science Plan, INCCA, March 2011.
21. National Water Mission, available at <http://india.gov.in/allimpfrms/alldocs/15658.pdf>. Also see Thakkar (2012).
22. The Ganges River Delta is the largest delta area on earth. With its extensive mangrove mud flats, swamp vegetation and sand dunes, it is characteristic of many tropical and subtropical coasts. The vegetation cushions the shoreline from wind and wave action while the mangrove trees provide a habitat and food for aquatic and terrestrial plant and animal life. See <http://www.sqidoo.com/riverdeltas>. Also see <http://www.banglapire.org/Research/tectonics-geophysics>.
23. 'A positive feedback is defined as "processes that amplify climate change," such as reduced absorption of CO₂ by the oceans and the ice-albedo effect. As

time goes on, scientists are finding more and more of these positive feedback mechanisms, further increasing the warming effect.' See 'Positive Feedback Effects of Climate Change Become Increasingly Apparent,' 20 August 2009, from www.climateshifts.org.

24. National Water Mission, *op cit*.
25. 'Jawaharlal Nehru National Solar Mission,' available at <http://india.gov.in/allimpfrms/alldocs/15657.pdf>.
26. *Economic Times* (2011a)' also see '35 out of 37 project developers have achieved required financial closure for grid power projects under JNNSM,' available at www.eai.in/club/users/nikoli/blogs/6921.
27. 'India Seizes Green Opportunity with 2011–2012 Union Budget,' available at www.theclimategroup.org.
28. Nuclear Power Corporation of India, www.npcil.nic.in/main/Aboutus.
29. See www.powermin.nic.in/indian_electricity_scenario/introduction.
30. The Planning Commission had set up an expert group to recommend integrated energy policy. Its report, submitted in 2006, deals with various sources and forms of energy (electricity, coal, oil, gas, nuclear, hydel energy, renewables including wind energy, solar energy, biofuels, wood plantations), the country's projected requirement and availability of resources, energy security, energy efficiency as well as research and development priorities. See http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf.
31. National Mission on Enhanced Energy Efficiency, available at <http://india.gov.in/allimpfrms/alldocs/15659.pdf>.
32. 'A Formula for More Land and Resource Grabbing: Dangers of the Green India Mission: Forest Movements' Joint Statement,' available at www.forestrightsact.com/statements-and-news/90-dangers-of-the-green-india-mission.
33. 'Draft Reports State Action Plans on Climate Change (SAPCC),' all submitted draft reports are available at <http://moef.nic.in/modules/others/?f=sapcc-2012>.
34. Delhi SAPCC. This is available at <http://ebookbrowse.com/states-sapcc-delhi-pdf-d68504>.
35. 'A case study of using CNG as a transportation fuel in Delhi,' Amit Pal, S. Majhi, O.P. Sharma, CBS Interactive Business Network Resource Library, Sept. 2009.
36. See theme paper on coal and coal-based thermal power.
37. 'Leakage, Mis-management Clog Delhi water utility,' Ghosh, P., and Chandran, R., *Mint*, April 29, 2009.
38. SAPCC draft reports are available in Ministry of Environment and Forests website at <http://moef.nic.in/modules/others/?f=sapcc-2012>.

Many States in the northeast are receiving funds from GIZ, the merged German 'development' agency, for preparing their SAPCCs. Several states

- have received funds from the UK's DFID agency for this purpose. See 'Summary of Discussion: National Consultation Workshop on Preparation of State Level Strategy and Action Plan on Climate Change,' available at <http://moef.nic.in/downloads/others/SAPCC-workshop-summary-2010>.
39. The SAPCCs of Himachal Pradesh, Madhya Pradesh, Manipur, Arunachal Pradesh, Odisha, all speak of REDD+. See draft SAPCCs as in note 38.
 40. 'Integrated Coastal Zone Management,' a World Bank assisted and guided project. See <http://web.worldbank.org/external/projects> for more details.

References

- Altaf, Anjum. 2011. 'Urbanization in India: Some Questions,' The SouthAsianIdea Weblog. <http://thesouthasianidea.wordpress.com/2010/09/22/urbanization-in-india-some-questions/>.
- Apparusu, Suman K. 2011. 'NAPCC-India: Climate Change, Gender and Innovation,' Change Planet Partners Climate Innovation Foundation (CPPCIF).
- Choudhary, B. and K. Gaur. 2010. 'Bt Cotton in India: A Country Profile,' ISAAA Series of Biotech Crop Profiles. Ithaca, NY: ISAAA.
- CSO. 2011a. *Energy Statistics 2011*. Central Statistics Office, Ministry of Statistics and Programme Implementation, <http://mospi.nic.in>.
- . 2011b. *National Accounts Statistics 2011—an Overview*. Central Statistics Office, Government of India.
- Diagle, Katy. 2010. 'Climate Change: India Faces Dire Increase in Floods, Droughts, Disease Due to Global Warming,' *Huffington Post*, 17 Oct. 2010.
- Down to Earth*. 2011. 'Environment Ministry Creates a Record in Forestland Diversion'—Chapter 1 Overview, 22 Sept. 2011, *Down to Earth*, www.downtoearth.org.in.
- Durban Climate Justice. 2011. 'The Dangers of REDD+,' 5 Dec. 2011. See <http://durbanclimatejustice.wordpress.com/2011/12/05/the-dangers-of-redd>.
- Econexus. 2011. 'EU bio-fuel target causes serious damage in the global south,' *Econexus*, June 2011, See www.econexus.info/topic/agrofuels-biofuels.
- Economic Times*. 2011a. 'The National Solar Mission Gathers Momentum with New Projects,' *Economic Times*, 11 May 2011.
- . 2011b. 'Union Budget 2011: Allocation for Space, Atomic Power Departments Hiked,' *Economic Times*, 28 Feb. 2011.
- Environmental Geology*. 1997. 30(3-4), April.
- Ghosh, P. and R. Chandran. 2009. 'Leakage, Mis-management Clog Delhi water utility,' *Mint*, 29 April 2009.
- GoI. 2008. Annual Plans—Ministry of Coal, Government of India, available at www.coal.nic.in/AnnualPlan.

- . 2011. 'Agriculture and Food Management,' *India Economic Survey* 2010–11. Ministry of Finance.
- . n.d. 'National Action Plan on Climate Change (NAPCC),' Prime Minister's Council on Climate Change, Government of India.
- Huaiyen Lanpao. 2011. 'No NE States except Assam Prepare Draft for State Action Plan on Climate Change,' *Huaiyen Lanpao* (Manipuri newspaper), 26 July.
- IFPRI. 2010. *Global Hunger Index 2010*. Washington D.C.: International Food Policy Research Institute.
- IRINnews. 2009. 'Global: Twelve Countries on Climate Change Hit List,' <http://www.irinnews.org/Report/85179/GLOBAL-Twelve-countries-on-climate-change-hit-list>.
- Kuehl, S.A., M.A. Allison, S.L. Goodbred and H. Kudrass. 2005. 'The Ganges-Brahmaputra Delta,' in L. Gosian and J. Bhattacharya (eds.), *River Deltas: Concepts, Models, and Examples*. SEPM Special Publication No. 83, p. 413–34.
- MoEF. 2010. Indian Network for Climate Change Assessment (INCCA) report, Ministry of Environment and Forests, Government of India.
- . 2011. 'National Mission for a Green India,' Ministry of Environment and Forests, Government of India; see <http://moef.nic.in/downloads/public-informations>.
- MoF. 2011. 'Combined Expenditure of the Centre and the States—Revenue and Capital,' *Indian Public Finance Statistics 2010–11*. New Delhi: Ministry of Finance, Government of India.
- MoS. n.d. 'Development of Indian Steel Sector Since 1991,' Ministry of Steel, Government of India, available at <http://steel.nic.in/development>.
- NFFPFW, NESPOL and DISHA. 2011. 'The Indian CDM: Subsidizing and Legitimizing Corporate Pollution,' Nov. 2011, can be accessed at www.thecornerhouse.org.uk.
- Pal, Amit, S. Majhi, O.P. Sharma. 2009. 'A Case Study of using CNG as a Transportation Fuel in Delhi,' CBS Interactive Business Network Resource Library, Sept. 2009.
- Rodell, Matthew, Isabella Velicogna and James S. Famiglietti. 2009. 'Satellite-based Estimates of Groundwater Depletion in India,' *Nature*, 460: 999–1002, 20 August 2009.
- Rodgers, W.A., Hemendra S. Panwar and Vinod B. Mathur. 2000. *Wildlife Protected Area Network in India: A Review*. Dehradun: Wildlife Institute of India.
- Sainath, P. 2011. 'Some States fight the trend but ...,' *The Hindu*, 5 December 2011, Available at www.thehindu.com/opinion/columns/sainath/article2687160.
- Sharma, Ashwani. 2008. 'Impact of Climate Change on Indian Agriculture,' October, <http://www.eco-web.com/edi/00447.html>.

- Sood, R. 2008. 'Cement Plants: How Many the State Can Sustain,' *Hill Post*, 19 January.
- SOPAC. 2004. *Environmental Vulnerability Index*, South Pacific Applied Geoscience Commission (SOPAC) and United Nations Environment Programme (UNEP).
- Thakkar, Himanshu. 2009. 'There is Little Hope Here,' South Asia Network of Dams, Rivers and People (SANDRP), see www.sandrp.in.
- . 2012. 'Water Sector Options for India in a changing Climate,' March, available at www.sandrp.in/wtrsect/.
- Whitley, Juliet. 2011. 'Global Policy Regime versus Indian and Odishan Approach on Climate Change: A Brief Analysis,' *RCDC Occasional Paper Series-2*. Bhubaneswar: Regional Centre for Development Cooperation.

Index

- Ahmad, Nesar, 197
- afforestation and reforestation
(A&R), 142
- Alliance of Small Island Nation
(AOSIS), 49
- Arjun Sengupta Committee
report, 190
- Asian Development Bank (ADB), 229
- Atomic Energy Commission, 91
- Baliga, B. P., 97
- Bali Action Plan 2007, 157–58
- base of the pyramid (BoP), 191–92
- Bhanumathi, K., 198
- biofuel and biotechnology, 121–22
- biomass energy, 100–01
- Bolivarian Alliance for the Peoples
of our Americas (ALBA), 50
- Buenos Aires Plan of Action, 45
- carbon dioxide, 2, 4, 7–8, 14–18, 22,
34, 41, 44, 52–53, 56, 64–67,
69, 83, 88, 97, 115, 121, 173,
186, 200–01, 204–05, 217–18,
220
- carbon flux/cycle, disruption, 4–7
- carbon forestry, 146
- carbon space, fallacy, 11–12
- carbon trading, 43, 49, 51, 54–57,
61–63, 122, 124, 132, 135,
148–49
- CARMA database, 98
- Cartagena Dialogue (2010), 50
- Central Electricity Regulation
Commission (CERC), 135–38;
statement of reasons (SOR), 136
- Central Intelligence Agency
(CIA), 186
- Central Mine Planning & Design
Institute Limited (CMPDI), 197
- Central Statistics Office (CSO), 218
- Central Water Commission
(CWC), 25
- Centre for Global Energy Studies
(CGES), 186
- Centre for Science and
Environment (CSE), 84, 197
- Centre of National Development
Planning (Bangladesh and
Nepal), 159
- Certified Emissions Reduction
credits (CERs), 43, 131
- Chernobyl disaster (1986), 95–96
- chlorofluorocarbons (CFSs), 4, 34, 41

- Clean Development Mechanism (CDM), 43, 45, 70–71, 100–01
116, 119, 121–39, 165, 170, 172, 200; benefits, 125
- climate change in India, 48, 50, 52, 79–80, 169, 176; adaptation, 44–45, 54, 155–66; and carbon equity, 57–61; crises and response of states, 211–29; deniers, 50; energy sector and, 79–80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106–08, 110; impact, 1–33, 46–47, 53, 55–56, 170–73, 177–78, 180, 201, 204; mitigation, 115–51; policies and plans, 213–29; politics, 62–64
- Climate Investment Funds, 166
- Climate Technology Centre, 48
- coal and coal-based thermal power, 179–206; mining, 79, 81, 83–85, 175, 180, 196–99, 200, 202, 204; consumption and pollution, 101, 180–82, 192; thermal power, 182–87
- Committee on Environmental Impacts of Wind Energy Projects (CEIWEP), 99, 100
- Common but Differentiated Responsibilities (CBDR), 42–43, 47, 54, 58, 63, 118
- community-based watershed management in Afghanistan, 161
- community forest management (CFM), 144
- compact fluorescent lamp (CFL), 119
- compressed natural gas (CNG), 119, 227
- Conference of Parties (CoPs), 11, 15, 116, 139, 143, 157
- Convention on Biological Diversity (CBD), 13, 143
- Delhi Ministerial Declaration, 45
- Direct Initiative for Social Health Action (DISHA), 130
- diurnal temperature range (DTR), 3–4
- Draconian Wild Life Protection Act, 1972, 147
- Durban Coalition for Climate Justice (2011), 228
- Durban Platform for Enhanced Action, 49
- earth hour, 109
- economic policy, 110
- ecosystem damage. *See* pollution
- Electricity Act (2003), 103, 136
- Electrostatic Precipitator (ESP), 132
- emission reduction through CDM, 132–35
- emission reduction units (ERUs), 44, 66, 71–72
- Employment Guarantee Act, 162
- energy consumption in India, 187–200; industrial, 105–08; residential, 108–10
- energy efficiency financing platform, 120
- energy efficiency mission, 119

- energy sector, India, 79–80
 biomass energy, 100–2; coal, 81–87; government initiatives, 103–04; hydroelectricity, 87–90; nuclear gas, 96–97; nuclear power, 91–96; solar energy, 102–03
- enhance energy efficiency mission, 225
- Environment and Forest, Ministry, 12, 122, 140, 143, 147, 211, 214, 227
- Environment Impact Assessment (2006, EIA), 119, 121, 128–29, 204
- Environment Management Plans (EMP), 119, 121
- European Kyoto markets, 138
- European Renewable Energy Council (EREC), 206
- European Union (EU), 44, 49
 emission trading scheme (EU-ETS), 43
- Farmer–Managed Natural Regeneration (FMNR), 160
- Fast Breeder Reactors, 94
- Federation of Indian Chamber of Commerce and Industry (FICCI), 74
- fishing practices, 19–20
- Five Year Plan India
 Eighth, 199, 217
 Eleventh, 81, 86, 100, 198, 217, 224
 Twelfth, 215
- fixed asset investment, 106
- floods, 27–28
- foreign direct investment (FDI), 58, 123
- Forest Right Act (FRA), 144–45, 148, 226
- Forest Survey of India (FSI), 139, 144, 146
- four well beings (social, economic, technological, environmental), 127–28
- free market carbon trading, 135–36
- Fukushima nuclear disasters in Japan, 92, 95
- Gadekar, Surendra, 95
- genetically modified (GM), 12, 220
- Geological Survey of India (GSI), 184
- geopolitics and climate politics, 49–50
- Ghosh, Somak, 134
- Glacial Lake Outburst Floods (GLOFs) in Bhutan, 162
- global climate controller, 14
- global cooling, 3
- global economic crises (2008–11), 218
- global emissions, 9, 46, 54, 107
- global greenhouse gas emissions, 48
- Global Hunger Index, 219
- global warming, 125, 217
 impact on climate change, 12–17, 21–22, 25, 40–41, 53, 55–56, 60, 63, 115–16, 204
 physical phenomena, 1–11
- Goddard Institute of Space Studies, U.S. (GISS), 3
- Goddard Space Flight Centre, 223

- gram sabha (village assembly), 142, 146, 226
- gram panchayats, 226
- Gravity Recovery and Climate Experiment (GRACE), 223
- Great Green Wall in Africa, 160
- green climate fund, 48–49, 62, 166
- Green India Mission (GIM), 119, 139, 142–43, 145, 147, 162, 226, 231
- greenhouse gases (GHGs), 2, 4–5, 11, 42, 54, 64–65, 67–69, 71, 73, 115, 117–18, 121–3, 129, 220, 222
- emissions, 104, 116, 132, 140, 218
- mitigation, 118, 120
- gross domestic product (GDP), 59, 106, 189–91, 193, 218, 221
- gross national product (GNP), 22, 152
- Hansen, James, 3, 205
- Hastings, Warren, 180
- health hazards from climate change, 17
- Heatly, Suetonius Grant, 180
- hydroelectricity, 184
- hydrofluorocarbon GFL Project, 129
- Indian Council of Forestry Research and Education, 139
- Indian Council for Remote Sensing, 140
- Indian Energy Exchange (IEX), 137
- Indian Forest Act (1927), 147
- Indian Institute of Tropical Meteorology (IITM), 2
- Indian Meteorology Department (IMD), 163
- Indian National Power Grid, 133
- Indian Network for Climate Change Assessment (INCCA), 18, 143
- Indo–Gangetic plains, 22
- Inspector General of Registration, 107
- Intellectual Property Rights (IPR), 58
- Integrated Coastal Zone Management Plan, 229
- Integrated Energy Policy, 96, 118, 123, 175
- Intergovernmental Panel on Climate Change, 4, 8, 14, 16, 18, 41, 42, 156, 215; assessment report, 2, 4, 7, 17, 22, 157, 204
- International Centre for Integrated Mountain Development (ICIMOD), 32
- International Conference on CHG, Villach, Austria, 41
- international electric power (IEP), 92
- International Energy Agency (IEA), 194
- International Institute for Environment and Development, 165
- International Resources Group System South Asia Private limited (IRGSSA), 228
- ITC, 130
- Jawaharlal Nehru National Solar Mission, 2009 (JNNSM), 75, 102, 213, 224

- Jindal South West Factory (JSW), 130–31
- Joint Forest Management (JFM), 144–45, 148–49, 172
- Karlekar, Shrikant, 21
- Kothari, Smitu, 198
- Krishnan, Radhika, 197
- Kutty, Mathsy, 134
- Kyoto Protocol, 4, 39–40, 42–50, 52–55, 58, 61–62, 72, 74, 116, 122–24, 138–39, 155–57; clean development mechanism transactions, 165
- La Nina, 3, 25
- Lahiri-Dutt, Kuntala, 197
- land use, land–use–change and forests (LULUCF), 44, 140
- Leadership in Energy and Environmental Design (LEED), 228
- least developed countries (LDCs), 165
- liberalization–privatization–globalization process (1995–96), 192
- low-carbon technologies, 48
- Major Economic Forum (MEF), 82
- malarial transmission projections, 30
- McBride, J.P., 201
- Michaelwoa, Axel, 132
- Mirant Corporation, 203
- Mission for Enhanced Energy Efficiency, 213
- Mission for Sustainable Agriculture, 213
- Mission for Sustaining the Himalayan Ecosystem, 213
- Mission on Strategic Knowledge for Climate Change, 213
- Mission on Sustainable Habitat, 213
- monsoon, change, 24–27; cyclone threat, 28–29; floods, 27–28; impact on forest, 30–34; risk of disease, 29–30
- Nairobi Work Programme (NWP), 165
- National Action Plan for Climate Change (NAPCC), 62, 102, 117–21, 135, 162, 172, 176, 213–17, 222, 229
- National Adaptation Programmes of Action (NAPAs), 165
- National Aeronautics and Space Administration (NASA), 163; satellite (thermal/infra-red), 14, 16
- National Afforestation Programme (NAP), 143
- National CDM Authority (NCDMA), 126–28, 134
- National Commission for Enterprises in unorganized Sector (2007, NCEUS), 190
- National Commission for Women (NCW), 199
- National Environmental Policy (2006), 119
- National Forest Carbon Accounting Programme, 143
- National Forum of Forest People and Forest Workers

- (NFFPFW), 99–100, 122, 130–33
- National Hydro Power Policy, 101
- National Mission for a Green India, 62
- National Mission on Sustainable Agriculture (NMSA), 219
- National Oceanic and Atmospheric Administration (NOAA), 13
- National Resource Defense Council (NRDC), 73
- National Solar Mission, 103
- National Water Mission (NWM), 213, 221–24
- natural cycles, 1, 4
- natural ecosystems, 1
- natural gas, 96–97
- Net Primary Productivity (NPP), 35, 143
- New York Academy of Sciences, 96
- nitrogen cycles, 4
- non-governmental organizations, 50–51
- non-timber forest produce (NTFP), 33
- Nordjysk Elhandel (Danish Company), 131
- North Eastern Society for Protection of Nature and Wild Life (NEPSON), 130
- nuclear energy, 81, 92–93, 118
- Nuclear Power Corporation of India (NPCIL), 91
- Oak Ridge National Laboratory (ORNL), 201
- ozone depleting substance (ODS), 165
- Peaking Emissions, 7–11
- Perform Achieve and Trade (PAT), 225
- Photovoltaics (PV), 102–03
- politics of climate, 39–63
- pollution, 1, 118, 128, 129, 192, 202
air, 130; carbon, 51, 186;
chemical, 129, 132, 171, 203, 204
coal, 82, 101, 180; water, 29,
130, 203, 217
- Poorest Areas Civil Society (PACS), 23–24
- Potrero Thermal Power Plant, 203
- poverty alleviation, 127
- Power Exchange of India Ltd. (PXIL), 137
- Pressurized Heavy Water Reactors, 92
- project design documents (PDDs), 126–27, 129, 133
- Prototype Fast Breeder Reactor (PFBR), 94
- Providing Regional Climates for Impact Studies (PRECIS), 23, 25
- public-private partnership (PPP), 61
- purchasing power parity (PPP), 189, 223
- Purdue University, 27
- rain cycle, change, 22–24
- Rajiv Gandhi Grameen Vidyutikaran Yojana (RGVY), 104, 108
- Ramesh, Jairam, 123–4
- Rawatbhata nuclear power plant (Kota, Rajasthan), 95
- reducing emissions from deforestation and forest

- degradation (REDD), 139–50,
 170, 172, 176, 226
 Regional Centre for Development
 Cooperation, Orissa, 215
 Regional Climate Model (RCM), 23
 Reliance Company, 130
 Sasan ultra-mega coal power
 projects, 131–32
 renewable energy (RE), 75, 81, 104,
 127, 136, 150, 161, 171, 174,
 180, 188, 206, 213, 225;
 certificate (REC), 135, 137–38
 sources, 97–98, 104; trading
 (RET), 62, 116, 122, 135, 139
 Renewable Energy Trading
 Certificate Registry (RETCR),
 137–38
 renewable purchase obligation
 (RPO), 103, 135–36
 Renuka Dam, Sirmour District,
 Himachal Pradesh, 162
 Rio Earth Summit, Brazil (1992), 41
 RWF (German power company), 131

 Sahel Solution (Africa), 160
 sea level rise and inundation, 18–19
 Sethi, R.K., 134
 small and medium enterprises
 (SME), 226
 soil and water assessment tool
 (SWAT), 24
 soil salinity, 19
 solar energy, 102–03, 161
 South Asia Network of Dams, Rivers
 and People (SANDRP), 215
 South Pacific Applied Geo-science
 Commission (SOPAC), 219

 SRF, 130
 State Action Plans on Climate
 Change (SAPCCs), 216,
 227–29
 State Electricity Regulatory
 Commission (SERC), 103, 136
 State Forest Departments (SFDs),
 143–44
 Subansiri Dam Project (Assam–
 Arunachal border), 91
 Summer, John, 180
 Sundarbans, 19–21, 33
 sustainable development, 40, 46, 59,
 68, 70, 72, 73, 124–30, 132
 Sustainable Management of Forest
 (SMF), 142
 Suzlon company, 130–31; Dhule
 project, Maharashtra, 99

 Tarapur Nuclear Power Plant, 204
 Tatas, 130
 The Energy Research Institute
 (TERI), 81, 96, 100, 105
 Thakkar, Himanshu, 215, 222
 Thermal Power Plants (TRPs), 200,
 202
 Tipaimukh Dam, Manipur, 91
 Tiroda Plant (Adani group), 132
 transuranic wastes (TRU), 93

 United Kingdom: meteorological
 office, 2, 17
 United Nation; Conference on
 Environment and
 Development (UNCED),
 40–41; Convention on
 Biological Diversity, 13;

- Declaration on the Rights of Indigenous Peoples, 52; educational scientific and cultural organization (UNESCO), 164; Environment Programme (UNEP), 41; Framework Convention on Climate Change (UNFCCC), 11, 39, 48, 55, 101, 116, 127–28, 131, 133, 135, 140, 142, 143, 155, 158–59; global environment facility, 165; Montreal action plan, 45; protocol (1987), 41; protocol fund (1990), 165
- Uranium Corporation of India, 92
- United States; bureau of land management, 99; Department of Agriculture (USDA), 163; environment protection agency, 202; government accountability office (GSO), 134; nuclear regulatory commission, 93–94; world resource institute (WRI), 191
- Vienna Convention on the Protection of the Ozone Layer (1955), 41
- Wikileaks revelation, 133–35
- wind energy, 98–100; and biomass projects, 133
- Wind Energy Generators (WEGs), 131
- World Bank, 109, 229; Forest Carbon Partnership Facility, 165
- World Climate Conference 1st, Geneva, Switzerland, 41
- World Coal Institute (WRI), 200
- World Hard Coal Production, 181
- World Health Organization, 17
- World Institute of Sustainable Energy (WISE), 82
- World Meteorological Organization (WMO), 41
- World People's Conference on Climate Change and the Rights of Mother Earth (2010), Bolivia, 51
- World Wildlife Fund (WWF), 22, 28
- Yes Bank, 134
- Yucca Mountain storage project, 94

CLIMATE CHANGE AND INDIA

ANALYSIS OF POLITICAL ECONOMY AND IMPACT

So far, the discussion on climate change in India has largely remained confined to two aspects of the problem: the international talks process and its inequities, and the potentially destructive impact of changes in earth's natural cycles caused by global warming. Attempting to go beyond the constraints of this discussion, this book explores the intersection of several processes that are related to climate change: not only dominant politico-economic processes in India and abroad usually grouped under the term 'climate politics', but also economic policies and their relationship to climate change and its impact on people. Through analysis of these processes and their often overlooked interrelations, it aims to discuss the multifaceted nature of the impact that 'climate change'—as a natural phenomenon, a political symbol and a focus of policy making—is likely to have on the majority of Indians.

Soumya Dutta is a researcher and activist involved in people's science action in various provinces of India, besides writing handbooks and pamphlets on a range of issues related to science and environment for teachers, activists and civil society organizations. He is associated with several people's movements and resistance struggles in India and has also been involved in joint actions and discussions with groups located in several other countries.

Soumitra Ghosh is an activist, film maker and researcher, who works among the forest communities of India. A co-editor of *Mausam*, the Indian e-journal on climate change, carbon trading and related issues, Soumitra researched and wrote about the clean development mechanism projects in India. He is associated with NESPON, an environmental CBO based in sub-Himalayan West Bengal, India; the All India Forum of Forest Movements & Forest Workers (AIFFM), an alliance of movements for forest rights; and the Durban Coalition for Climate Justice.

Shankar Gopalakrishnan is a full time activist with the Campaign for Survival and Dignity, a national platform of Adivasi and forest dwellers' organizations, and is also associated with organizations of urban workers. He has worked on issues of communalism, economic policy, urban workers' struggles, migrant labour, and forests and forest rights.

C. R. Bijoy is an independent activist-researcher involved with indigenous people's/Adivasi issues and struggles, human rights and democratization of governance. He is with the Campaign for Survival and Dignity, a national coalition of Adivasi and forest dwellers' organizations, India.

Hadida Yasmin is a researcher presently appointed as an assistant professor in St. Xavier's College, Siliguri at Department of Zoology. She did her PhD in Zoology in the year 2007 from North Bengal University and has been researching various climate-related issues—in particular, carbon trading and clean development mechanism projects since 2005.

Cover Design: Pravin Mishra

□ 275



www.daanishbooks.com



www.rosalux-southasia.org

ISBN 978-93-81144-32-9



9 789381 144329