

Climate Change Policies in the Asia-Pacific:

**RE-UNITING CLIMATE CHANGE
AND SUSTAINABLE DEVELOPMENT**

IGES White Paper

Institute for Global Environmental Strategies (IGES)

Institute for Global Environmental Strategies (IGES)

2108-11 Kamiyamaguchi, Hayama, Kanagawa, 240-0115, Japan

Tel: +81-46-855-3720 Fax: +81-46-855-3709

E-mail: iges@iges.or.jp URL: <http://www.iges.or.jp>

**Climate Change Policies in the Asia-Pacific:
Re-uniting Climate Change and Sustainable Development**

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IGES White Paper

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Foreword

The Institute for Global Environmental Strategies (IGES) White Paper series has been designed to extract broad findings from research conducted by IGES and its partner research institutes to bring critical environmental policy issues to the attention of the region's policy makers. Since climate change will be the top agenda item for the region in 2008, the second issue of the White Paper focuses on climate change.

The Bali Action Plan was adopted at the thirteenth session of the Conference of the Parties (COP13), which was held in Bali, Indonesia in December 2007. The Action Plan provides a roadmap to the post-2012 climate regime to be agreed upon by the end of 2009. This year is the start of the first commitment period of the Kyoto Protocol, and there are important processes already underway to help bring about an agreement on the future regime as stipulated by the Action Plan. The G8 Summit to be held in Toyako, Japan in July 2008, in particular, will look at climate change as the most important agenda item. Since Asia is increasingly emerging as a significant source of greenhouse gases (GHG), and the Asia-Pacific region is among the most vulnerable to impacts from climate change, meaningful involvement of countries in the region in these processes is considered essential.

The White Paper consists of three main parts. Part I contains detailed discussions on climate change strategies. Part II looks at climate change related issues in several sectors including forestry, energy (biofuels), waste management, and groundwater, as well as key institutional and industry developments in response to climate change challenges. Part III brings together the main conclusions and recommendations.

The objectives of the White Paper are:

- (i) to feature the most important environmental policy agenda for the region in 2008—a response to the challenges posed by climate change in Asia and the Pacific;
- (ii) to broadly summarise the current climate change situation in Asia and identify emerging issues, and to review effective policy approaches that have been adopted in the region;
- (iii) to present a number of broad policy recommendations that will promote sustainable development focussing on climate friendly development for the region, drawing from IGES research programmes, where appropriate; and
- (iv) to identify the critical policy research agenda over the next decade for the region.

While examining climate change issues from multiple perspectives, the White Paper summarises current policy responses from around the Asia-Pacific region and attempts to sort effective climate change policy from non-effective policy. The White Paper attempts to set out general principles and priorities to promote the adoption of

successful mitigation and adaptation policies that would fully accommodate the national needs and situations that vary so widely in the region. A particular focus is on Asia-Pacific regional positions regarding post-2012 policy regimes and possible negotiating positions, which builds on research and consultations conducted by IGES at multiple levels over the past few years.

The second White Paper has been drafted throughout FY2007 and will be published in conjunction with the final symposium of the 10th anniversary of IGES held in June 2008.

I would like to acknowledge the efforts of a group of expert peer reviewers, who, at short notice, provided constructive input to an early draft of the White Paper. I am also grateful to the members of the IGES Board of Directors who reviewed the draft and provided invaluable input. My greatest appreciation goes to the multiple authors of the various chapters who have worked tirelessly on the White Paper in addition to their other research activities. Drafting has been carried out at IGES retreats over the last ten months, throughout which Prof. Akio Morishima, special research advisor to IGES, provided practical advice. The drafting process was coordinated by Mr. Hideyuki Mori and Dr. Peter King, with full participation of all IGES projects. A special note of appreciation is given to the patient work conducted by all IGES staff involved in bringing the White Paper to fruition on time. Finally, the excellent work of the IGES Secretariat and their selected editors and translators has ensured a high quality publication which we hope will make a real contribution to ongoing policy debate on climate change issues in the Asia-Pacific region.

Hayama, Japan
19 May 2008

Prof. Hironori Hamanaka

Chair, Board of Directors
Institute for Global Environmental Strategies

List of Authors

Overall supervisor:

Hironori Hamanaka, Chair of the Board of Directors, IGES

Special advisor:

Akio Morishima, Special Research Advisor, IGES

Overall manager:

Hideyuki Mori, Vice President, IGES

Chief coordinator:

Peter King, Senior Policy Advisor, IGES

Chapter 1 - Introduction

Lead author:

Peter King, Senior Policy Advisor, IGES

Contributing author:

Hideyuki Mori, Vice President, IGES

Chapter 2 - Aligning Actions on Climate and Development: Asia at the Crossroads

Lead authors:

Ancha Srinivasan, Principal Researcher and Manager, Climate Policy Project, IGES
Eric Zusman, Policy Researcher, Climate Policy Project, IGES

Contributing authors:

Toshihiro Uchida, Researcher, Climate Policy Project, IGES
Jun Ichihara, Researcher, Climate Policy Project, IGES
Takuro Kobashi, Researcher, Climate Policy Project, IGES
Hitomi Kimura, Researcher, Climate Policy Project, IGES

Chapter 3 - Mitigation and Adaptation – Sectors and Actors

Lead author:

Peter King, Senior Policy Advisor, IGES

Contributing author:

Hideyuki Mori, Vice President, IGES

Chapter 4 - Reduced Emissions from Deforestation and Forest Degradation in Developing Countries: Risks and Opportunities for Rural Communities in the Asia-Pacific Region

Lead author:

Henry Scheyvens, Manager, Forest Conservation Project, IGES

Contributing authors:

Kazuhiro Harada, Policy Researcher, Forest Conservation Project, IGES

Federico Lopez-Casero, Policy Researcher, Forest Conservation Project, IGES

Chapter 5 - Prospects and Challenges of Biofuels in Asia: Policy Implications

Lead authors:

Mark Elder, Senior Policy Researcher and Manager, Biofuels Project, IGES

Prabhakar Sivapuram, Policy Researcher, Biofuels Project, IGES

Jane Romero, Policy Researcher, Biofuels Project, IGES

Naoko Matsumoto, Consultant, Biofuels Project, IGES

Chapter 6 - Urban Organic Waste – From Hazard to Resource

Lead authors:

Magnus Bengtsson, Policy Researcher, Waste and Resources Project, IGES

Janya Sang-Arun, Researcher, Waste and Resources Project, IGES

Contributing authors:

Oyuna Tsydenova, Intern, Waste and Resources Project, IGES

Toshizo Maeda, Policy Researcher, Kitakyushu Office, IGES

Chapter 7 - Groundwater and Climate Change: No Longer the Hidden Resource

Lead authors:

Sangam Shrestha, Policy Researcher, Freshwater Project, IGES

Yatsuka Kataoka, Senior Policy Researcher, Freshwater Project, IGES

Chapter 8 - Institutional Changes in Asia in Response to Climate Change

Lead authors:

Xin Zhou, Senior Policy Researcher and Manager, Programme Management Office, IGES

Hideyuki Mori, Vice President, IGES

Contributing authors:

Maricor De Leoz Muzones, Researcher, Programme Management Office, IGES

Hidenori Nakamura, Policy Researcher, Programme Management Office, IGES

Peter King, Senior Policy Advisor, IGES

Chapter 9 - Responsible Business - Energy Efficiency Solutions

Lead author:

Venkatachalam Anbumozhi, Manager and Senior Policy Researcher, Business and the Environment Project, IGES

Contributing authors:

Yutaka Takaishi, Sub-Manager and Senior Policy Researcher, Business and the Environment Project, IGES

Xianbing Liu, Policy Researcher, Business and the Environment Project, IGES

Yusuke Matsuo, Researcher, Business and the Environment Project, IGES

Chapter 10 - Conclusions and Recommendations

Lead author:

Peter King, Senior Policy Advisor, IGES

Contributing author:

Hideyuki Mori, Vice President, IGES

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All Chapters

Taka Hiraishi, Co-chair, IPCC GHG Inventory Task Force Bureau, Member, Board of Directors and Senior Consultant, IGES

Bill Glanville, Vice President and Chief Operating Officer, International Institute for Sustainable Development (IISD)

Chapter 2 - Aligning Actions on Climate and Development: Asia at the Crossroads

John Drexhage, Director, Climate Change and Energy, International Institute for Sustainable Development (IISD)

P. R. Shukla, Professor, Indian Institute of Management

Shuzo Nishioka, Senior Research Advisor, IGES

Chapter 4 - Reduced Emissions from Deforestation and Forest Degradation in Developing Countries: Risks and Opportunities for Rural Communities in the Asia-Pacific Region

Duncan Macqueen, Senior Researcher, Forestry, International Institute for Environment and Development

Chapter 5 - Prospects and Challenges of Biofuels in Asia: Policy Implications

Shiro Saka, Graduate School of Energy Science, Kyoto University

Tatsuji Koizumi, Senior Economist, Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries, Japan

Shinichi Arai, Project Researcher, Integrated Research System for Sustainability Science (IR3S), University of Tokyo

Hiroaki Matsuda, Integrated Research System for Sustainability Science (IR3S), University of Tokyo

Venkatachalam Anbumozhi, Manager and Senior Policy Researcher, Business and the Environment Project, IGES

Daisuke Sano, Policy Researcher, Biofuels Project, IGES

Satoshi Kojima, Policy Researcher, Biofuels Project, IGES

Anindya Bhattacharya, Policy Researcher, Biofuels Project, IGES

Nissar Gorsl, Intern, Biofuels Project, IGES (data collection)

Utako Tadokoro, Intern, Biofuels Project, IGES (data collection)

Michael Kohen, Intern, Biofuels Project, IGES (data collection)

Chapter 6 - Urban Organic Waste – From Hazard to Resource

Mushtaq Ahmed Memon, Programme Officer, International Environmental Technology Centre, UNEP

Xiaofei Pei, Senior Researcher, Policy Research Centre for Environment and Economy (PRCEE), SEPA

Chapter 7 - Groundwater and Climate Change: No Longer the Hidden Resource

Sumrit Chusanathas, Director of Groundwater Assessment Bureau, Department of Groundwater Resources, Ministry of Natural Resource and Environment

Ashim Das Gupta, Consultant, Water Resources Management, Panya Consultant Co. Ltd.

Liu Xiang, Professor, Department of Environmental Science and Engineering, Tsinghua University

Shinichiro Ohgaki, Professor, Graduate School of Engineering, University of Tokyo

Ganesh Prasad Shivakoti, Professor, Agricultural and Natural Resources Economics, School of Environment, Resources and Development, Asian Institute of Technology

Satoshi Takizawa, Professor, Graduate School of Engineering, University of Tokyo

Chapter 8 - Institutional Changes in Asia in Response to Climate Change

Hisakazu Kato, Professor, Graduate School of Law, Nagoya University

Norichika Kanie, Associate Professor, Department of Value and Decision Science, Graduate School of Decision Science and Technology, Tokyo Institute of Technology

Yukari Takamura, Professor, International Law, Faculty of Law, Ryukoku University

Yong Ren, Deputy Executive Director, Policy Research Centre for Environment and Economy (PRCEE), Ministry of Environmental Protection, China

Yasuko Kameyama, Senior Researcher, Centre for Global Environmental Research, National Institute for Environmental Studies

Shinichi Okuda, Associate Professor, Faculty of Political Science and Economics, Takushoku University

Chapter 9 - Responsible Business - Energy Efficiency Solutions

Sivanappan Kumar, Dean, School of Environment, Resources and Development, Asian Institute of Technology

Masayuki Sasanouchi, Senior General Manager, CSR & Environmental Affairs Div., Toyota Motor Corporation

Qwanruedee Chotichanathawewong, Assistant President, Thailand Environment Institute

P. D. Jose, Indian Institute of Management, Bangalore

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Abbreviations and Acronyms

3R	reduce, reuse, recycle
ADAPT	Assessment and Design for Adaptation to Climate Change: a Prototype Tool
ADB	Asian Development Bank
AOSIS	Alliance of Small Island States
APEC	Asia-Pacific Economic Cooperation
APFED	Asia-Pacific Forum for Environment and Development
APP	Asia-Pacific Partnership on Clean Development and Climate
A/R	afforestation/reforestation
ASEAN	Association of South East Asian Nations
B2	2% palm oil blend for diesel vehicles
BAU	business as usual
BEE	Bureau of Energy Efficiency, India
BMA	Bangkok Metropolitan Administration
BRA	business-related agency
CBD	Convention on Biological Diversity
CBO	community based organisation
CCAP	Center for Clean Air Policy, USA
CCB	Climate, Community and Biodiversity
CCS	carbon capture and storage
CCX	Chicago Climate Exchange
CDM	clean development mechanism
CDM-EB	CDM Executive Board
CECPA	China Environmental Culture Promotion Association
CER	certified emissions reduction
CESR	corporate environmental and social responsibility
CGWB	Central Ground Water Board, India
CHED	Commission on Higher Education and Development, Philippines
CMA	China Meteorological Administration
CNG	compressed natural gas
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
COP	Conference of the Parties
CSR	corporate social responsibility
DA	Department of Agriculture, Philippines
DENR	Department of Environment and Natural Resources, Philippines
DepEd	Department of Education, Philippines
DFA	Department of Foreign Affairs, Philippines
DGR	Department of Groundwater Resources, Thailand
DNA	designated national authority
DOE	designated operational entity

DOEP	Department of Energy, Philippines
DILG	Department of Interior and Local Government, Philippines
DOST	Department of Science and Technology, Philippines
E3	3% ethanol blended petrol
EA	environment agency
EE	energy efficiency
EIA	environmental impact assessment
EIT	economies in transition
EL	executive leadership
EMB	Environmental Management Bureau, Philippines
EPFL	Ecole Polytechnique Federale de Lausanne
ERPA	emission reduction purchase agreement
ESCO	energy service companies
ETBE	ethyl tertiary-butyl ether
ETS	emissions trading scheme
EU	European Union
FA	foreign affairs agency
FAO	Food and Agriculture Organisation of the United Nations
FCPF	Forest Carbon Partnership Facility
FDI	foreign direct investment
FSC	Forest Stewardship Council
FYP	five year plan
G8	Group of Eight (developed countries)
G77+China	Group of 77 developing countries plus China
GAP	Green Assistance Plan, Japan
GBEP	Global Bioenergy Partnership
GDP	gross domestic product
GEF	Global Environment Facility
GERIAP	Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific
GHG	greenhouse gas
GLOF	glacier lake outburst flood
GW	gigaWatt (10 ⁹)
GWPH	Global Warming Prevention Headquarters, Japan
ha	hectares
HCFC	hydrochlorofluorocarbon
HCMC	Ho Chi Minh City, Vietnam
HDI	human development index
HIV/AIDS	human immunodeficiency virus/acquired immunodeficiency syndrome
IACCC	Inter-Agency Committee on Climate Change, Philippines
IACM	inter-agency coordination mechanism
IATAL	international air travel adaptation levy
ICAP	International Carbon Action Partnership
IDRC	International Development Research Centre, Canada
IEA	International Energy Agency
IES	integrated environmental strategies
IETA	International Emission Trading Association
IFCA	Indonesia Forest Climate Alliance
IFPRI	International Food Policy Research Institute
IGES	Institute for Global Environmental Strategies
IIASA	International Institute for Applied Systems Analysis
IMC	Inter-Ministerial Committee on UNFCCC, Republic of Korea

IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
IPR	intellectual property rights
ISO	International Standards Organisation
ITTO	International Tropical Timber Organisation
IWRM	integrated water resources management
JBIC	Japan Bank for International Cooperation
JI	joint implementation
JICA	Japan International Cooperation Agency
JS	Joint Secretary; heads a division or cell within the MoEF structure of India
JV	joint venture
KEEI	Korea Energy Economics Institute
KEMCO	Korea Energy Management Cooperation
KFQ	Korean Foundation for Quality
KFS	Korea Forest Service
kg	kilogram
km	kilometre
kt	kilotonne
KMA	Korean Meteorological Administration
KP	Kyoto Protocol
L	litre
L/ha	litres per hectare
L/t	litres per tonne
LA	leading agency
LCA	life cycle analysis/assessment
LCS	low carbon society
LDC	least developed country
LDCF	Least Developed Country Fund
LGU	Local Government Unit
M	million (Mt, ML, Mha, MJ etc.)
M2M	methane to markets
MA	Meteorology Agency, Republic of Korea
MBT	mechanical-biological treatment
MCIE	Ministry of Commerce, Industry and Energy, Republic of Korea
MCMGEC	Meeting of the Council of Ministers for Global Environmental Conservation, Japan
MDG	millennium development goals
MEA	multilateral environment agreements
METI	Ministry of Economy, Trade and Industry, Japan
mg/L	milligrams per litre
MJ	megajoule
mm	millimetre
MNC	multinational corporation
MOA	Ministry of Agriculture, China
MOAF	Ministry of Agriculture and Forestry, Republic of Korea
MOAFF	Ministry of Agriculture, Forestry and Fisheries, Japan
MOCC	Ministry of Communications, China
MOCIE	Ministry of Commerce, Industry and Energy, Republic of Korea
MOCT	Ministry of Construction and Transportation, Republic of Korea
MOECSST	Ministry of Education, Culture, Sports, Science and Technology, Japan

MOE	Ministry of Environment
MOEF	Ministry of Environment and Forestry, India
MOEK	Ministry of Environment, Republic of Korea
MOF	Ministry of Finance, China
MOFA	Ministry of Foreign Affairs
MOFAT	Ministry of Foreign Affairs and Trade, Republic of Korea
MOFE	Ministry of Finance and Economy, Republic of Korea
MOJ	Ministry of Justice, Republic of Korea
MOLIT	Ministry of Land, Infrastructure and Transport, Japan
MOP	meeting of the Parties
MOSTC	Ministry of Science and Technology, China
MOSTK	Ministry of Science and Technology, Republic of Korea
MPI	Ministry of Electric Power, China
MSW	municipal solid waste
MW	megawatt
N ₂ O	nitrous oxide
NBS	National Bureau of Statistics, China
NAP	national action plan
NAPA	national adaptation programme of action
NC	national communication to the UNFCCC
NCA	National CDM Authority, India; also the DNA of CDM, India
NCCCC	National Coordination Committee on Climate Change, China
NCCCCG	National Climate Change Coordinating Group, China
NCCLG	National Climate Change Leading Group, China
NCSA	national capacity self assessment
NDRC	National Development and Reform Commission, China
NECERLG	National Energy Conservation and Emission Reduction Leading Group
NEDA	National Economic and Development Authority, Philippines
NEDO	New Energy and Industrial Technology Development Organisation
NEPA	National Environmental Protection Agency, China
NEV	net energy value
NIES	National Institute of Environmental Studies, Japan
NGO	nongovernmental organisation
NPC	National People's Congress
ODA	official development assistance
OECD	Organisation for Economic Cooperation and Development
OFR	on-farm reservoir
OGPC	Office for Government Policy Coordination, Republic of Korea
OPA	other participating agency
OPEC	Organisation of the Petroleum Exporting Countries
OPM	Office of Prime Minister, Republic of Korea
PAG-ASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration, Philippines
PCSD	Presidential Commission on Sustainable Development
PNCC	Philippine Network on Climate Change (NGO coalition)
PNG	Papua New Guinea
POA	project activities under a programme of activities
ppm	parts per million
PTFCC	Presidential Task Force on Climate Change, Philippines
R&D	research and development
RDA	Rural Development Administration, Republic of Korea

RE	renewable energy
RED	reduced emissions from deforestation
REDD	reduced emissions from deforestation and forest degradation in developing countries
RESCO	renewable energy service corporation
ROK	Republic of Korea
RSB	Roundtable on Sustainable Biofuels
RSPO	Roundtable on Sustainable Palm Oil
SA	science agency
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCCF	Special Climate Change Fund
SD-PAM	sustainable development policies and measures
SDPC	State Development and Planning Commission, China
SEPA	State Environmental Protection Administration, China
SERC	State Electricity Regulatory Commission, China
SETC	State Economic and Trade Commission, China
SFA	State Forestry Administration, China
SGP	Small Grant Programme
SIDS	small island developing states
SME	small and medium enterprises
SPC	State Planning Commission, China
SSTC	State Science and Technology Commission, China
SWDS	solid waste disposal site
t	tonne
t/yr	tonnes per year
tCO ₂ e	tonnes of carbon dioxide equivalent
TAI	The Access Initiative
TERI	The Energy and Resources Institute, India
TFC	Task Force Committee for the UNFCCC
UK	United Kingdom
UN	United Nations
UNCCD	UN Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Commission on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP/RISØ	United Nations Environment Programme/Risoe Centre, Denmark
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USEPA	United States Environment Protection Agency
VER	voluntary emissions reduction
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development
WTO	World Trade Organisation

Note: Throughout this report, “\$” means US dollars unless otherwise indicated.

“Asia” encompasses all Asian and Pacific countries, except where otherwise indicated.

Executive Summary

Climate change is real and Asia is already experiencing its adverse impacts. Projections from the Intergovernmental Panel on Climate Change (IPCC) suggest that such impacts will become even more intense in the future. While the contribution of developing countries in Asia to global greenhouse gas (GHG) emissions is increasing rapidly, per capita emissions are still low and developmental challenges remain significant. Future efforts by developed countries to reduce GHG emissions through cost-effective mitigation actions, however, offer the possibility of creating new opportunities in developing countries in Asia that will contribute to their sustainable development. Strategies to integrate climate and development actions, therefore, require prompt and careful consideration from policymakers in Asia. Part I of the White Paper explains why it is necessary to integrate climate change and sustainable development in Asia and how this might be best achieved.

Global estimates from the IPCC and Stern Review, and limited evidence from Asia, suggest that the costs of inaction on climate change would be many times the costs of action. Therefore, a multi-pronged approach to drastically slow down the rate of growth of GHG emissions in Asia, stabilise and eventually reduce them, is necessary and affordable. Likewise, adaptation efforts to manage the unavoidable impacts of climate change at all levels are crucial and must be set in motion now.

Much of the infrastructure necessary to accommodate rapid economic growth in Asia will be built in the near future. Therefore, efforts to avoid “technology lock-in” and pursue a sustainable development path are urgently needed. Sustainable development in Asia must be based on low carbon, resource efficient and qualitatively different development practices that do not deny the right to development and improvements in the quality of life. This transition will require an informed appreciation of Asia's current status (both good and bad) and concrete recommendations for which direction the region should take in the future as outlined in the White Paper in four priority areas.

In comparison to other regions, developing countries in Asia offer the most cost-effective opportunities (e.g. energy efficiency (EE) improvement and energy diversification) for GHG mitigation and for integration of climate concerns into non-climate policies. The region also offers enormous opportunities (e.g. reversing unsustainable land use practices that lead to deforestation and degradation) for exploiting synergies between climate and other international regimes on biodiversity, desertification, and other areas.

The size of the population and ecosystems vulnerable to the impacts of climate change also distinguish Asia from other regions, and failure to adapt adequately will be a major threat to meeting millennium development goals (MDG) in the region. Even though optimal paths towards adaptation are poorly understood at present, a host of “no-

regrets” actions to adapt to climate change can be taken which are cost effective and make economic and environmental sense. Opportunities also exist for mainstreaming adaptation concerns in development planning and assistance.

Despite strong linkages between climate change and development, and vulnerability of Asian populations and ecosystems, climate policy has thus far received limited attention from policymakers in several Asian countries. The lack of know-how in formulating integrated development and climate actions, and in exploiting various “win-win” options and co-benefits remain serious barriers in the region, leading to significant gaps between the formulation and implementation of effective policies affecting the climate.

Some progress has been demonstrated in developing institutional structures (e.g. inter-ministerial agencies, designated national authorities [DNA], and national committees on climate change), but most of these structures are designed to take advantage of the Kyoto Protocol’s clean development mechanism (CDM) and energy investment frameworks supported by international financial institutions. No country in the region has developed a comprehensive national policy framework on adaptation.

The vision of developing a low carbon, climate-resilient Asia will require an acceleration of efforts in at least four areas: (i) promoting the involvement of developing Asia in the design and implementation of the climate regime beyond 2012; (ii) enhancing the adaptive capacity of Asian populations and ecosystems; (iii) exploiting the power of market mechanisms for the benefit of Asian societies, especially the most vulnerable groups; and (iv) transforming the social, industrial and economic infrastructure towards a low carbon economy and implementing policies to integrate climate change and sustainable development.

Post-2012 climate regime

The participation of developing countries in Asia in climate change negotiations has not been commensurate with the challenges, costs or opportunities outlined above. Proactive efforts by all countries to design and implement a new global policy framework for mitigation and adaptation that reconciles global interests on the climate with Asian priorities for development are crucial.

Since 2005, the Institute for Global Environmental Strategies (IGES) has held a series of national, sub-regional and region-wide consultations with Asian policymakers and other stakeholders on the future climate regime. The consultations found that there are shared concerns and interests in the region in (i) integrating climate concerns in development planning; (ii) streamlining the CDM by reducing its complexities and uncertainties; (iii) enhancing the focus on adaptation; (iv) facilitating the development, deployment and diffusion of low carbon technologies; and (v) strengthening the capacity of negotiators, the private sector and financial institutions. Differences between Asian countries were also evident, however, on issues such as (i) ways to consider equity in the future climate regime; (ii) the form, time and type of involvement of developing countries; (iii) national preferences for low carbon technologies; and (iv) approaches to, and funding for, facilitating adaptation, especially regarding the need for a separate protocol and the introduction of market-based mechanisms.

Further discussions and analysis of post-2012 regime proposals revealed that efforts to reflect Asian concerns on energy security and developmental needs in global climate negotiations have been far from satisfactory. Future efforts, therefore, should focus on demonstrating and facilitating the most pragmatic measures to mainstream climate concerns in energy and development planning, and on supporting implementation of integrated development and climate strategies at various levels. Since energy security is an issue in which both developing and developed countries share common interests, the future climate regime should facilitate further development of climate-friendly energy policies in Asia by sharing good practices, setting standards and guidelines, building adequate human and institutional capacities, and initiating new partnerships for regional collaboration.

A few post-2012 regime proposals have involved participation from Asian researchers and policymakers; several fail to reflect Asian needs, concerns and aspirations, and none examine the implications for future development of different Asian countries. For example, studies on the implications of a global GHG emission reduction target of 50-70% by 2050 on development prospects of Asian countries are inadequate and urgently needed. Indeed, none of the reviewed proposals simultaneously meet distributional equity, cost-effectiveness, environmental outcomes, and flexibility criteria, thereby demonstrating the complexity of developing a comprehensive, equitable and effective framework. As most countries in the region favour a comprehensive multilateral framework instead of a fragmented regime based on regional or thematic coalitions, efforts to realise the former must be accelerated.

Our preference is for a framework that relies on the established United Nations Framework Convention on Climate Change (UNFCCC) concepts of common but differentiated responsibility for GHG mitigation, the polluter pays principle and precautionary approaches for adaptation. A multi-stage framework characterised by (i) progressively increasing emission reduction and adaptation commitments or actions; (ii) new grouping of countries based on responsibility, vulnerability, capability and mitigation potential; and (iii) a differentiated framework of incentives and compliance provisions should be the basis for discussions on the future climate regime. One condition is that the grouping of countries should be reassessed at the beginning of each commitment period. Furthermore, in all countries, efforts to reduce inter- and intra-regional, high- and low-income group disparities in emissions should be promoted, recognised and rewarded. Developing countries in Asia must not shirk from their mitigation and adaptation responsibilities, but the form of participation of each developing country can and should vary significantly from the current regime's emphasis on "targets and timetables."

Since technology is a cornerstone of several non-UNFCCC initiatives, which have the potential to provide the necessary paradigm shift to reduce GHG emissions in selected industries, building synergies between UNFCCC and non-UNFCCC initiatives is crucial. In the short term, the climate regime can provide CDM opportunities in methane recovery and additional income for project developers, while the methane to markets (M2M) initiative and/or the Asia-Pacific Partnership on Clean Development and Climate (APP) can provide access to necessary technologies. Likewise, technologies for carbon capture and storage (CCS) may be transferred through the APP, if the future climate regime makes CCS projects eligible for the CDM. The future regime should also facilitate synergies among North-South and South-South technology cooperation and transfer initiatives, especially in relation to adaptation.

Since widespread deployment of low carbon technologies is crucial to realising the vision of a low carbon economy in Asia, innovative options should be considered such as (i) collaboration with developing countries in Asia in the early stages of technology development leading to joint ownership of intellectual property rights (IPR); (ii) creation of a regional technology acquisition fund, which could be structured to buy-out IPRs and make privately owned technologies available for deployment in Asia's developing countries; and (iii) establishment of a regional/international code of compulsory licensing for low carbon technologies along the lines of approaches taken for treatment of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) or the US Clean Air Act. Ensuring additional finance through innovative public and private support mechanisms is critical to make the currently available technologies commercially viable and to provide seed funding to help achieve economies of scale for emerging new technologies.

Adaptation to climate change

Adaptation should receive as much attention as mitigation because several countries in the region are already facing the impacts of climate change. Designing a new protocol on adaptation may enhance its profile at the international level, but the process may require considerable resources and time in terms of negotiation. A combination of both “top-down” support and “bottom-up” engagement approaches is crucial to advance the adaptation agenda in the region. For this to happen, the identification of options for mainstreaming adaptation concerns in development planning and assistance in Asia both at policy and operational levels is important. The agenda for adaptation financing at the international level needs to be clarified. Options for (i) enlarging the funding base and developing flexible but clear guidance to access adaptation funds; (ii) differentiating between actions that can be funded inside and outside the climate regime; and (iii) creating market mechanisms and incentives for the private sector to become more involved in adaptation must be explored.

Enhancing adaptive capacity of Asian populations and ecosystems will require multiple actions at various levels. Regional cooperation mechanisms on adaptation must be addressed on a high priority basis, especially in dealing with trans-boundary issues such as integrated river basin management, forest fire management and early warning systems. All policy areas, including those of development assistance agencies, must undergo “adaptation screens” to ensure that those policies do not exacerbate current and/or future vulnerabilities. Obstacles and tipping points for “climate-proofing” of infrastructure development and mainstreaming adaptation concerns in development planning must be assessed. A regional platform to support adaptation efforts through the creation of an Asian clearinghouse for databases and a compendium of good adaptation practices is considered vital.

Development of national policy frameworks for adaptation is urgent but there is significant scope to build on existing institutional frameworks. Asian developing countries are a good reservoir of indigenous knowledge and local coping strategies to deal with climate variability. Opportunities for integrating such knowledge in local adaptation plans and for widespread application of such strategies in new areas must be explored. An assessment of the current financial instruments available to support adaptation in Asia suggests that the amount of resources flowing through such instruments is inadequate. Therefore, options for (i) enlarging the funding base for

adaptation both within and outside the UNFCCC; (ii) involving the private sector (e.g. insurance sector) in facilitating adaptation at regional, national and local levels; and (iii) establishing a region-wide adaptation financing and insurance facility should be examined.

Market mechanisms

Although many Asian developing countries have expressed a keen interest in drawing benefits from the CDM and despite the initial expectation that the CDM could be made into an effective tool to promote sustainable development, concerns about the CDM implementation in Asia remain salient. Concerns include complex modalities for project approval, lack of a development dividend in projects delivering high certified emissions reduction (CER), uncertainty over post-2012 carbon credits, and uneven geographic distribution of projects within Asia. Developing countries in Asia, in close collaboration with the UNFCCC Annex I parties, should strive to remove each of these barriers so that the power of market mechanisms can be fully exploited, particularly for the most vulnerable segments of Asian society.

In the short term, strengthening of human and institutional capacities and improving the operational setting for CDM implementation in Asian countries is an urgent priority. Based on IGES' experience with integrated capacity strengthening for CDM in Asian developing countries, substantial scope exists for streamlining the CDM approval process in both host countries and the CDM Executive Board. As many CDM projects in Asia are unable to get off the ground due to insufficient underlying financing, innovative options should be explored such as the use of official development assistance and other multi-source funding approaches to cover projects risks, especially in least developed countries (LDC) and middle-income countries. The Asian Development Bank should consider using its CDM facility to support post-2012 CERs, similar to the World Bank's "carbon market continuity fund."

In the medium term, the scope of CDM should be expanded to include sector-based and policy-based approaches based on the experience gained from approval of the "Programme of Activities" in different Asian countries. On a priority basis, binding transnational sectoral emission limits for some key sectors represented by multinational companies such as steel, cement and aluminium must be explored. Likewise, CDM should be expanded to cover sectors that can deliver significant reductions in GHG emissions in Asian countries, such as forestry. In the medium to long term, options for promoting the developmental dividend of CDM projects in Asia through quantifying and preferentially rewarding projects with high developmental benefits must be explored both within and outside the UNFCCC. Japan and other G8 countries should play a lead role in supporting Asian projects with high developmental dividends by streamlining guidelines for development assistance.

Sustainable development co-benefits

The widely-held assumption in Asia that GHG mitigation is inherently incompatible with sustainable development must be corrected. Despite numerous integrated climate and development policies in Asia (as identified from World Resources Institute's database on sustainable development policies and measures [SD-PAMs]), awareness of these

policies remains limited in the region. Therefore, institutional frameworks and incentives to promote the awareness and implementation of such policies and to mainstream the concept of co-benefits of mitigation and adaptation in national planning need to be revisited in the short term.

In the medium to long term, opportunities for promoting co-benefits through building on synergies among multilateral conventions should be examined. The future climate regime discussions must examine options for funding SD-PAMs in return for emission reductions as compared with the business-as-usual scenarios. Suitable metrics of performance that enable the monitoring of co-benefits should be developed. Operational support from the climate framework, for example, through the maintenance of a registry of SD-PAMs and identifying synergies between sustainable development benefits and GHG mitigation and adaptation, would be helpful.

Communities in several Asian countries have acquired a significant amount of experience with innovative low carbon lifestyle patterns including material reuse and recycling. However, recent trends and future projections in Asia suggest development patterns with an ever-increasing carbon footprint. A roadmap to achieve rapid transformation of social, industrial and economic structures in each developing Asian country must be built on the basis of national circumstances, without sacrificing the right for development. Blueprints for switching to an emission stabilisation pathway do not yet exist even in developed countries; hence developing countries in Asia must not wait to learn lessons from developed countries. Future investments in the region, especially in industrial development, urban planning and transportation sectors, must aim to reduce energy use and GHG intensity. Likewise, policies for transformation of the energy sector (e.g. power distribution networks) to more renewable energy (RE) sources and to small-scale, decentralised power generation in homes and businesses will be crucial. Improvement of communication channels to accelerate informed debate on options for achieving a low carbon society is also vital for the region.

Climate policy alone will not solve the climate problem, as climate outcomes are influenced not only by climate-specific policies but also by the mix of development choices made and the development paths along which these policies lead (IPCC 2007). Asian policymakers, therefore, have a significant role to play in choosing appropriate development paths. In so doing, they should ensure that the region's climate policies are resilient, remaining flexible in the face of an inherently uncertain issue, while holding firm in the face of opposition from carbon-intensive industries and other vested interests. Striking this balance will depend upon the adaptability of key sectors (discussed in Part II) to climate friendly development and the alignment of climate concerns with sustainable development policies in the region.

In Part II of the White Paper, selected sectors are investigated to illustrate some of the complexities in aligning climate concerns and sustainable development policies in Asia-Pacific. The capabilities of key actors (government, civil society and the private sector) and how they have changed in order to respond to the challenges of climate change completes the analysis.

Reduced emissions from deforestation and forest degradation in developing countries

With deforestation as the second largest anthropogenic source of GHG emissions and a major contributor to unsustainable development, any scheme that will reduce the current rates of deforestation and forest degradation should be supported. Moreover, some policy responses to climate change, like biofuels, are inadvertently promoting deforestation in Asia. Therefore, the optimum policy choices in containing deforestation and forest degradation require careful analysis. The forest sector is an ideal vehicle for demonstrating the need to conjoin climate change and sustainable development policies, because millions of forest-dependent people are potentially affected by decisions by governments in developing countries that could constrain access to Asia's forests in return for payment by developed countries to sequester carbon dioxide.

The concept of providing a new incentive for forest conservation through international financial transfers connected with carbon, or reduced emissions from deforestation and forest degradation in developing countries (REDD), is now high on the international climate agenda. REDD is a low-cost option for reducing global GHG emissions; there are numerous side-benefits (like biodiversity conservation), and it has increasing support in the climate change negotiations. For REDD funding to be consonant with sustainable development objectives it must promote accountable and transparent forest governance, secure and equitable forest tenure, and sustainable livelihoods. The dilemma is that the developing countries that would benefit most from this proposed funding mechanism are those with historically weak forest governance and a poor record in defending the rights of forest-dependent communities.

For a credible REDD scheme to be agreed upon, negotiators need to resolve fundamental questions on trade of avoided deforestation emissions, use of a national or project approach, the scope of coverage, and mechanisms for community participation. Independent standards need to be formulated to protect the environment and ensure that forest-dependent people are not disadvantaged. Nevertheless, a well-designed REDD mechanism would not only contribute to reduced GHG emissions, it would also provide opportunities to reform forest governance and alleviate rural poverty, while promoting sustainable development in Asia's developing countries. The current piloting of different models will help to clarify many of these issues, before adopting a comprehensive scheme in accordance with the Bali Action Plan.

Biofuels

Biofuels, a renewable form of energy produced from plants or waste, have attracted significant attention in Asia because of their potential to reduce GHG emissions, promote national energy security, and revitalise rural economies. However, the reality is more complex, and more nuanced policies are needed. In particular, the rush to promote biofuels could be counterproductive if they are not produced by sustainable means. Research based on a life cycle assessment approach shows that first generation biofuels (i.e. from food crops, oil palm, sugarcane and other crops) could produce more energy than they consume in the production process and reduce GHG emissions, but this depends on the production process including energy and fertiliser inputs, and the nature of any land use changes. Inappropriate production methods or land use changes (e.g. destroying forests to plant biofuel crops) could result in

increased GHG emissions. Worse, by competing with food production, biofuels may increase the price of basic food items, making them unaffordable to the poor, and trigger new agricultural lands to be opened up through deforestation. Use of oil-bearing plants, like *jatropha*, to avoid the food-fuel conflict by utilising supposed “wastelands” may deprive landless poor farmers of common grazing land and offer no reversion to food consumption during times of drought or other food shortages. It is also questionable whether its production could be limited to wastelands.

Subsidising unsustainably produced biofuels or mandating their blending into existing transportation fuels could be counterproductive, especially on a large scale. Global trade in biofuels may help developed countries in Europe to meet their Kyoto Protocol commitments but unintentionally accelerate deforestation in tropical Asian forests.

Second generation biofuels have significantly more potential for reducing GHG emissions and avoiding the food-fuel conflict. They can be produced from a wider range of sources including agricultural, forest, and some municipal and other waste, and microalgae. The potential to convert waste to liquid fuel is particularly attractive. Unfortunately, the chemical conversion processes are more complicated, probably more costly, and not yet commercially viable. Even if the technology becomes commercially viable, the policy challenge will be to organise a collection system and address the issue of transport costs. Nevertheless, additional research and development should be devoted to this avenue rather than blindly continuing to follow the short term, easier path of converting existing crops into bioethanol and biodiesel.

In the near term, the policy priority should be to promote sustainable production methods for biofuel feedstocks, especially avoiding direct or indirect deforestation. This should start with sustainability standards and certification. Asian countries should conduct their own biofuel related research since their conditions are different. Trade related policies should not be prioritised until sustainability issues have been resolved. Biofuels are not a silver bullet, and they need to be placed in the context of comprehensive energy policies, which include conservation and other renewable energy forms.

Urban organic waste and climate change

Safely disposing of urban organic waste has been a problem for as long as the history of human settlement. Organic waste is not just a health hazard and public nuisance but also contains valuable nutrients and energy, so merely removing it to a municipal dumpsite on the outskirts of the city is not a sustainable solution. The typical response of transforming uncontrolled dumpsites into more sanitary forms of landfill may control the health hazards, but then decomposition of waste under anaerobic conditions generates methane, a potent GHG. Methane from solid waste disposal sites contributes 3-4% of anthropogenic GHG emissions, and is growing. Under *status quo* urban waste management scenarios, methane emissions are projected to increase by 2.6-9.6 times in Asia’s developing countries, due to increasing urban populations and rising per capita consumption.

Compared to open dumps and landfills, biological treatment methods (composting and anaerobic digestion) are shown to have considerable advantages. They can drastically reduce emissions of GHGs, recycle nutrients and be introduced at small scale and at

low cost, thus contributing to sustainable development. Composting is identified as an especially interesting option since it is highly adaptable and suitable for community-driven initiatives. By examining policies and practices related to organic waste management in several Asian countries and six municipal case studies, a number of policy measures to promote more widespread use of composting are suggested.

The results show that centralised composting of fresh market waste, without any intention to generate income from selling the product, can only treat a limited share of a city's waste, but seems to be an easy and suitable model to start with. Composting of household waste is more difficult, because it requires changes in individual behaviour, although there are some successful examples that have typically started small and gradually expanded. Careful segregation at source is crucial for projects that need to create revenues by selling their product to farmers as soil conditioner or fertiliser. Municipal solid waste management is a good example of an issue where an integrated approach can generate significant co-benefits. Therefore, policymakers should promote more widespread use of composting, both as a way to solve some local development challenges and environmental problems and as a contribution to combating climate change.

Groundwater

Billions of people in the Asia-Pacific depend on groundwater for irrigation, drinking water and industry, but it has been poorly managed, partly because it is out of sight. Climate change impacts on groundwater now pose a completely new management challenge. Climate change will make some parts of Asia wetter, others drought affected; glaciers will melt, and seasonal flows will change; and everywhere climate variability and extreme events will become more problematic. Sea level rise, especially in deltaic regions and coral atolls, will increase saline intrusion into groundwater, making it unsuitable for use. Other changes like subsidence, soil temperatures and chemistry, impacts on transmissivity, land use changes and effects on evapotranspiration may have impacts on groundwater in ways that are not yet defined or adequately modelled. Groundwater may increase in importance and help to ameliorate the worst effects of climate change on water resources and sustainable development. However, once seriously damaged, recovering groundwater resources requires vast amounts of funds and time.

Policy responses to these changes should provide examples of how climate change adaptation and sustainable development need to be linked, although so far most countries in Asia have not realised or responded to the multiple effects of climate change on their water management plans. Policies and adaptation measures are needed in relation to structural adaptation (e.g. rainwater harvesting, artificial recharge of aquifers, desalination plants, underground reservoirs, and dams) and institutional changes (e.g. legislation, tenure rights, improved governance, groundwater pricing, zoning, and access to adaptation funds). However, to fill the knowledge gaps and reduce uncertainty regarding the prediction of impacts of climate change on groundwater resources and evaluation of future groundwater management options, more research is needed.

Institutions

All countries in the Asia-Pacific have new institutional arrangements to respond to the global challenges of climate change. The White Paper examines how national governments are structuring their agencies to respond to climate change, and how countries are mobilising the participation of other stakeholders, including local governments, the private sector, civil society and academia to play a role in climate related activities. Five Asian countries were selected for comparative study: China, India, Japan, the Philippines, and the Republic of Korea (ROK).

Most countries in Asia have developed some form of inter-agency coordination to ensure integrated domestic climate policies. Common success factors found in building domestic institutional capacity include (i) strong overall coordination by an executive leadership body; (ii) industry and environment agencies as joint lead agencies; (iii) extensive involvement of other agencies covering sectors related to mitigation and adaptation; and (iv) well established mechanisms to empower stakeholder participation. Nevertheless, there is no “ideal” institutional arrangement that will work equally well for all countries.

The attention to domestic mitigation and adaptation arrangements, as part of ongoing national sustainable development efforts, needs to be enhanced. The enigma of why climate change has been treated in some countries as a stand-alone development issue rather than being integrated into existing national sustainable development structures, measures and implementation plans requires further research. The final goal of effective institutions is to achieve grass-roots behavioural change. Unless the relationship between specific institutional arrangements and associated behavioural changes at individual and group levels are understood, the effectiveness of institutions cannot be assessed.

Industry

Globally, industry is increasingly aware of its responsibility for climate change and, despite much uncertainty surrounding the issue, private sector investment decisions that will have implications for the next 30-50 years are tentatively factoring in CER pricing and the possibility of carbon taxes. Eventually, Asian industries will have to make a transition to non-fossil fuels, as current projections indicate that Asia will contribute almost one third of global GHG emissions by 2030. In the short term, however, major contributions can be made by minimising energy demand through adoption of a wide range of EE options. A vigorous EE strategy will enable greater emission reductions than any other climate change alternative with short payback periods and will add to bottom line profits as energy prices continue to increase. Many companies have made a profit while saving 20–40% of energy use, with payback periods of only one to three years.

The apparent barriers limiting greater government intervention in EE include a lack of sectoral targets, standards and incentives, and perverse subsidies. Barriers limiting private sector adoption of EE include risk aversion, minimal capacity of small industries, access to energy efficient technologies, finance, and human resources. Some actions have been taken in Asia (e.g. energy conservation policies, tax incentives and subsidies, voluntary certification and agreements, supply chain cooperation, energy

service companies, and research and development support) to overcome these barriers and many lessons can be drawn from Japan's experience. The key element in effective EE strategies is implementation of combined actions in a parallel, coordinated and consultative manner. The future research agenda should focus on collecting detailed case study information from all sectors and all sizes of companies on successful implementation of EE measures.

Conclusion

The historic development pathway of Europe and the US is clearly not sustainable in developing Asia, with its larger population, constrained by resource limitations, and now facing the global challenges of climate change. So far, however, Asia has not framed an alternative future that simultaneously provides for an escape from poverty, improves standards of living, and responds to the need for a low carbon, climate resilient sustainable development pathway. Asian countries need to become more involved in the global climate change negotiations, if only to ensure that sustainable development and climate change remain as a single pathway to development, not diverging tracks.

Four priorities were identified in the White Paper: (i) building a fair, effective, and flexible post-2012 climate regime; (ii) enhancing the region's adaptive capacity; (iii) utilising market mechanisms more effectively; and (iv) building a low carbon society and exploiting developmental co-benefits, of which the task of transforming Asia's social, industrial and economic infrastructure towards a low carbon society is the most daunting. Nevertheless, the climate change regime beyond 2012 can be designed to assist Asia in this transformation—encompassing market mechanisms that transfer financial resources into the world's most cost-effective climate change mitigation options and ensuring that future infrastructure investments are designed and implemented to enhance the adaptive capacity of Asia's population and ecosystems.

Cost-effective mitigation options that are intimately linked with sustainable development were detailed in the REDD proposals, and are potentially available in second generation biofuels using Asia's abundant organic waste, and in composting municipal solid waste. Protecting the region's groundwater resources, as a reserve or insurance for future climate variability that will impact on surface water resources already stretched to the limit, is just one example of the inevitable adaptation measures that must be integrated with sustainable development planning and implementation.

These far reaching mitigation and adaptation measures, however, will not happen unless Asia's multiple stakeholders—governments, the private sector, and civil society—stand together with a shared vision of a low carbon, climate resilient future for Asia and the Pacific.

As a strategic environmental policy research institute, IGES is committed to continue bringing together all of these stakeholder groups and forging a common vision for the future, conducting research that contributes to real-time policy processes, and disseminating informed views on policy options for stronger reconciliation of climate change responses and sustainable development. On the occasion of its 10th anniversary, IGES hopes that this White Paper will be a significant contribution to this agenda.

PART I

| CHAPTER 1 |

INTRODUCTION



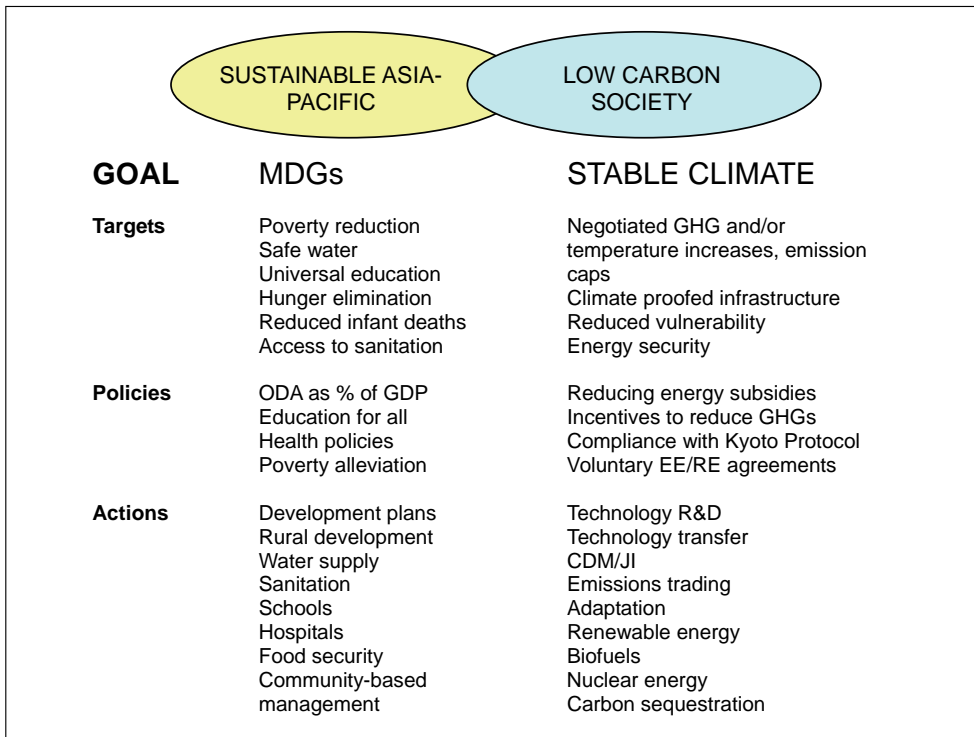
Chapter 1

Introduction

What are the current views on climate change in Asia and the Pacific and how are policymakers responding?

Development policies that contribute to climate change mitigation and adaptation and climate change policies that contribute to sustainable development are both of equal interest, although they are not always mirror images. A key concern addressed by the White Paper is that sometimes the climate change and sustainable development agendas appear to be diverging rather than converging (fig. 1.1). Part I of the White Paper explains why it is necessary to integrate climate change and sustainable development in Asia and how this might be best achieved.

Figure 1.1. Tale of two (or one) worlds?



Climate change has been a relatively low priority on the policy agendas of most developing countries in the region, partly due to more pressing economic development and poverty reduction priorities. Not all developing countries, however, view climate change in the same way. Low-lying, small island developing states (SIDS) or countries with vast floodplains (like Bangladesh) view their situation from the perspective of a potential victim of sea level rise. Other developing countries with large populations are under international pressure to curb their total emissions of GHGs, as they are making a major contribution to global emissions, despite relatively low per capita emissions. Others fall between these extremes.

Developed countries in the region also view their response to climate change differently. Notably, Japan has achieved some decoupling of its economic growth from energy consumption and has hosted a variety of attempts to reach global consensus on reduction of GHGs (especially through the Kyoto Protocol).

If there is such diversity in how countries view the global phenomenon of global warming and climate change, then there is equal or greater diversity among different interest groups within each country, ranging from ignorance or scepticism to significant concern and voluntary action. Different interest groups frame their views of climate change according to their own perceived costs and benefits of action or inaction. Part of the research needed in the region is to make reluctant groups more aware of the real costs and benefits, particularly if they are operating under mistaken assumptions, or to identify effective policy interventions that will change their assessment of the respective costs and benefits.

Given this wide range in the way individuals, groups and countries view climate change in the Asia-Pacific region, what kind of policy analysis might lead to a better understanding of how decision makers are responding now and might be prevailed upon to respond in a more proactive way in the near future? Political science suggests that the most promising approach to understanding the realities of the climate change debate and its policy responses is to analyse how various interest groups are interacting in each political setting (Oates and Portney 2001). Evidence from a wide range of environmental policy decisions in developed countries suggests that the ultimate policy outcome depends on an amalgam of group interests and general social welfare maximisation.

A simplistic analysis suggests that there has been a risk that two parallel “worldviews” could emerge in Asia-Pacific (fig. 1.1). In the “sustainable development” perspective, the logic of the World Commission on Environment and Development, Agenda 21, Johannesburg Plan of Implementation, and the Millennium Development Goals (MDG) applies, with its primary focus on poverty alleviation and human well-being. In the “low carbon society” worldview, the economic development challenge is focussed on how to decouple production and consumption from an apparent “addiction” to fossil fuels.

Both worldviews have tended to develop their own language and collection of acronyms, communities of interest, policies, negotiating skills and implementation mechanisms. An entire new industry sector is building up around climate change, covering renewable energy (wind, solar, wave, biofuels), carbon trading, carbon offsets, technology development, carbon capture and sequestration, and disaster insurance, etc.

A specific challenge for this White Paper is to ensure that the two worldviews remain integrated into the unified logic, priorities and mechanisms of the sustainable development worldview, as that priority agenda is still far from being solved in developing countries of Asia and, arguably, climate change cannot be solved if global inequality is not diminished. It is possible that the further these two views diverge, the greater the likelihood that inequality and poverty in Asia-Pacific would increase, and the higher the likelihood that poor policy choices would be made.

Why is sustainable development policy important in solving the climate change issue in Asia and the Pacific?

There is growing recognition and acceptance that climate change is an important issue in the Asia-Pacific region, though many developing countries believe that controlling GHG emissions is primarily the responsibility of developed countries. Many countries in this region still believe that combating climate change will damage their prospects for economic growth rather than open up new opportunities for a different form of growth. Major emitters like China and India recognise that they will eventually have to do something about their own total GHG emissions but, for now, economic growth and poverty reduction remain their national priorities. Nevertheless, developing countries are quick to latch onto financial mechanisms like the clean development mechanism (CDM) that will help developed countries meet their own emission reduction targets in a cost-effective manner while simultaneously contributing to economic growth in developing countries with low cost financing. Many countries, including China and India, are also interested in energy efficiency, energy security and decoupling economic growth from energy consumption, while acknowledging that continued rapid economic growth will mean that total emissions may only slow down rather than reverse.

Other countries that see themselves as fundamentally victims of climate change, particularly the low-lying SIDS in the Pacific Islands region and countries with large low-lying river deltas, are more interested in adaptation rather than mitigation, and also expect the developed countries that are mainly causing the problem to assist them to adapt. Some, like Tuvalu, even have contingency plans that involve part of the population migrating to New Zealand or Australia (Government of Tuvalu 2004). They often have little potential for CDM projects and little interest in mitigating their miniscule contribution to total GHG emissions. They are, however, potential beneficiaries of technology development in renewable energy, as imported fossil fuels are currently a major drain on their economies.

Accordingly, one starting point for analysing policy considerations is to recognise that climate change involves managing a global commons (Hardin 1968). For many centuries the atmosphere was treated as if it had no limits. One of the first signs that the atmosphere had exceeded its capacity to absorb and assimilate waste gases from human activities was the sudden and unexpected appearance of the massive ozone hole over the Antarctic. Hence, there are many parallels between the policy considerations that lead to the multilateral approach culminating in the Montreal Protocol and current climate change debates. The principal differences are that (i) the ozone hole did not immediately threaten billions of people or the global economy; (ii) a very limited set of causes and precursor chemicals was identified as the culprit; (iii) cost-effective substitutes and technologies were available to replace the refrigerants and aerosol sprays responsible; and (iv) the total cost was relatively small compared to

climate change. Despite the success of the Montreal Protocol in removing chlorofluorocarbons from use, the ozone hole remains and it is likely to take 50-60 years before this atmospheric wound is healed. Large systems like the global climate system have inbuilt stabilising mechanisms that have evolved over billions of years. Once destabilised, the climate system will take a very long time to re-equilibrate even if the cause (increasing concentrations of GHGs) is fully redressed.

From all that is known about managing other forms of common property (grazing areas, fishing grounds, forests, etc.), mutual trust, clear rules, transparent targets, comprehensive participation, cooperation, and significant sanctions for breaking the rules are the hallmarks of successful and sustainable common property management regimes (Ostrom 1990). From this perspective the Kyoto Protocol could have been viewed as an early trust building exercise, rather than a comprehensive solution to the climate change issue. Unfortunately, some major actors declined to ratify the protocol, making it a flawed policy response to a common property issue from the outset and not building up the requisite level of mutual trust.

Most of the developed countries that agreed to be part of the Kyoto Protocol have set their initial targets and have three main mechanisms (joint implementation, CDM and carbon emission trading schemes) to help them achieve those targets. However, despite the likelihood that these targets will be met globally it is now widely acknowledged that the targets are not ambitious enough and the mechanisms have not been utilised sufficiently. The period after the first commitment period (2008-2012) will require much more ambitious targets and new mechanisms to achieve those targets. The developed countries that opted out of the Kyoto Protocol, notably the United States, will also need to find a way of building up trust and working with the global community to set new targets and ways of achieving those targets, in addition to their existing commitments on technology development.

Although it may be viewed by some as having failed, the Kyoto Protocol has contributed to the establishment of the foundation for international cooperation with regard to climate change and GHG reduction requirements. Institutional arrangements like the CDM Executive Board and designated national authorities (DNA) have been established. The primary focus now, in the process that was initiated in Bali in December 2007, is on how to build on that foundation in future negotiations and establish robust climate change regimes with short/mid/long-term implications.

As outlined in the following chapter, developing countries are prepared to be part of a multilateral response effort post-2012, but only if such an agreement contributes to economic development rather than stunting the economic growth engine. Many countries in Asia and the Pacific have a clearly defined national interest in finding mutually acceptable and new international and national policy commitments for combating climate change, albeit from slightly different motivations. These positions are derived from the interplay of various interest groups with public policymakers, their understanding of the costs and benefits, and their relative power and influence. Above all, countries in the Asia-Pacific region want to find policy combinations that will allow them to continue economic growth and either mitigate or adapt to climate change, without trading away their own growth potential. While there is an undoubted need in the region to find sustainable development policy solutions to alleviate poverty, postponement of global solutions to climate change may only make matters worse in the end. The costs of inaction could be much greater than the costs of action.

For all these reasons, four priorities are identified in Chapter 2 for consideration by the region's policymakers:

- (a) achieving global participation in the future climate regime through more effective involvement of developing countries in Asia-Pacific;
- (b) enhancing the adaptive capacity of the region's vulnerable populations;
- (c) exploiting the power of market mechanisms, primarily for mitigation actions; and
- (d) realising the vision of a sustainably developed and low carbon society through effective design of policies with joint climate and developmental benefits.

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| CHAPTER 2 |

ALIGNING ACTIONS ON CLIMATE AND DEVELOPMENT: ASIA AT THE CROSSROADS



Chapter 2

Aligning Actions on Climate and Development: Asia at the Crossroads

Summary

Climate change is real and Asia is already experiencing its adverse impacts. The Intergovernmental Panel on Climate Change (IPCC) predicts that these impacts will become worse in the future. While the contribution of developing countries in Asia (hereafter referred to as 'developing Asia') to global greenhouse gas (GHG) emissions is increasing, the per capita emissions remain low and developmental challenges remain significant. Global estimates from the IPCC and the Stern Review, and limited evidence from Asia, suggests that the costs of inaction could be several times the costs of action. Thus, a multifaceted approach to enhance mitigation action and strengthen adaptation is needed.

The good news is that developing Asia offers some of the world's most cost-effective mitigation and adaptation opportunities. These possibilities exist in improving energy efficiency and renewable sources of energy, exploiting synergies among multilateral environmental agreements (MEA), integrating mitigation strategies into non-climate policies, and mainstreaming adaptation into development planning. The bad news is that climate policy has thus far received less attention than would be desirable from senior policymakers and politicians in Asia. The lack of attention has resulted in few policies that effectively integrate climate and development concerns, institutional structures that are chiefly designed to attract carbon investment from market mechanisms, and the absence of national policy frameworks for adaptation.

Developing Asia's participation in climate change negotiations has not been commensurate with its contribution/vulnerability to climate change. As a result, very few post-2012 regime proposals reflect Asian needs or aspirations. Developing a framework that reconciles global climate interests with Asian development priorities is critical. Rather than solely relying on the Kyoto-style "targets and timetables," a post-2012 framework may include (i) progressively increasing emission reduction and adaptation commitments or actions; (ii) new groupings of countries based on responsibility, capability, mitigation potential, and vulnerability; and (iii) a differentiated schedule of incentives and compliance provisions.

The deployment of low-carbon technologies will be important in Asia. This will require building synergies between United Nations Framework Convention on Climate Change (UNFCCC) and non-UNFCCC initiatives as well as other measures such as the joint ownership of intellectual property rights (IPR) and innovative financing. Adaptation should receive as much attention as mitigation in Asia. This will necessitate greater

adaptation financing and stronger financial mechanisms at the international level, enhanced cooperation on transboundary issues and sharing of best practices at the regional level, and effective integration of local knowledge into adaptation plans at the national and sub-national levels.

Despite considerable interest in Asia in the clean development mechanism (CDM), concerns regarding approval modalities, developmental benefits, post-2012 carbon credits, and geographic and technological inequity remain salient. In the short-term, strengthening human/institutional capacities and finding innovative options for underlying financing could remove some of these barriers. In the medium term, sector-based and policy-based approaches and the promotion of the developmental dividend could address additional barriers. Developmental co-benefits, if recognised and rewarded properly, could partly offset the costs of mitigating GHGs in Asia. Institutional frameworks and incentives to promote the implementation of policies with co-benefits, therefore, must be revisited in the short term. Metrics that enable the monitoring of co-benefits in a post-2012 regime should be developed for the medium term.

A roadmap to achieve rapid transformation of social, industrial and economic structures based on each Asian country's national circumstances is needed. Though developed countries should devise their own blueprints and make concerted actions to stabilise GHG emissions, developing countries in Asia must not wait to learn lessons from other regions. In doing so, it should be recognised that climate policy alone will not solve the climate problem.

1. Setting the context

As highlighted in Chapter 1, while the international community has been working to find effective solutions to the problem of climate change for the past 25 years, progress has been patchy and relatively slow. The year 2007, however, might have been a major turning point in global climate policy for several reasons. First, the awarding of the Nobel Peace Prize to the IPCC and the former US Vice-President Al Gore brought considerable awareness of the issue worldwide. The IPCC concluded that climate change was “unequivocal” and that it was “very likely” due to anthropogenic activities (IPCC 2007). Second, the publication of the Stern Review of the Economics of Climate Change in late 2006, and the convening of several high-profile meetings throughout 2007 (e.g. the United Nations (UN) Security Council meeting, the UN General Assembly thematic dialogue, the G8 Heiligendamm Summit, and the Asia Pacific Economic Cooperation (APEC) meeting) built up considerable political momentum. Third, and perhaps most importantly, the agreement on the “Bali Action Plan” at the 13th Conference of the Parties (COP13) to the UNFCCC, is expected to herald significant changes in international climate policy leading to an agreement on a new regime by the end of 2009 (box 2.1).

This chapter examines how Asia, a region that is culturally and politically diverse and that is experiencing unprecedented economic growth in some countries but enduring lingering poverty in other countries, can grapple with this complex challenge. It begins by demonstrating that Asia's contribution to global GHG emissions is increasing rapidly and that Asia will suffer significantly from the impacts of climate change. Later it is argued that mitigating such risks will require the region's climate policies to be resilient,

remaining flexible in the face of an inherently uncertain issue, while holding firm in the face of opposition from carbon-intensive industries and other vested interests. It is suggested that striking this balance will depend upon the adaptability of key sectors (forestry, water, etc. discussed in part two) and the strong alignment of climate concerns with sustainable development policies.

Box 2.1. The Bali Action Plan

The Bali Action Plan may be considered a significant milestone in the negotiations toward the post-2012 climate regime not only because it contains a roadmap, an agenda and a 2009 deadline, but also due to concurrent progress in discussions on all four building blocks of the climate regime beyond 2012 – mitigation, adaptation, technology and finance. In terms of mitigation, delegates agreed to consider “measurable, reportable and verifiable nationally appropriate mitigation commitments or actions by developed country Parties” and “cooperative sectoral approaches and sector-specific actions.” An agreement on the management of the adaptation fund was reached, and discussion on reducing emissions from deforestation and financing mechanisms moved forward. In addition, there was agreement to start a strategic programme to scale up investment in the transfer of mitigation and adaptation technologies. Moreover, through the establishment of a separate ad-hoc working group on long-term cooperative action, an inclusive process with a long-term goal was created. Some of the implications of the Action Plan for developing countries in Asia are briefly discussed below.

The future negotiations will consider “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.” A key consideration is that the Action Plan secures various support mechanisms for mitigation efforts by developing countries, including “technology cooperation in specific sectors,” “cooperation on research and development,” “positive incentives and innovative means of funding,” and “mobilization of public- and private-sector funding and investment.” During negotiations, developing countries need to specify barriers to implementing mitigation actions, so that concrete support from developed countries can be institutionalised in the new climate regime. Similarly, obstacles to pursuing synergies between GHG mitigation and sustainable development must be identified. In addition, clarity on words such as “*measurable, reportable and verifiable*” must be improved as there is potential to interpret these words differently.

1.1. Asia’s contribution to climate change

Recent estimates suggest that Asia accounts for 27% of the world’s energy-related GHG emissions and this proportion is likely to increase to 40% by 2030. The region is predicted to experience a steady rise in the urban population,¹ a sharp increase in energy use² and motorization, and continued reliance on fossil fuels³ and energy-intensive industries (IEA 2007, USAID 2007). The announcement in June 2007 by the Netherlands Environmental Assessment Agency that China surpassed the USA as the

largest emitter of carbon dioxide (CO₂) in 2006 may be of greater symbolic interest than substantive import (MNP 2007). However, it is part of a general picture (table 2.1) suggesting that the region has become and will continue to be a major source of emissions (IEA 2007).

Table 2.1. Energy-related CO₂ emissions by region in 2005

Region	Total CO ₂ Emissions (million tonnes)	CO ₂ / Pop. (tCO ₂ / capita)	CO ₂ / GDP (kgCO ₂ / 2000\$)	CO ₂ / GDP (PPP) (kgCO ₂ / 2000\$ PPP)
World	27,136	4.22	0.75	0.50
OECD (excluding Japan and the Republic of Korea)	11,247	11.29	0.49	0.43
Middle East	1,238	6.62	1.58	0.91
Former USSR	2,303	8.08	4.39	1.10
Non-OECD Europe	263	4.87	1.73	0.61
Asia	9,295	2.75	0.97	0.48
Latin America	938	2.09	0.58	0.29
Africa	835	0.93	1.14	0.40

Source: IEA (2007)

While total emissions may be viewed with justifiable concern, they should not overshadow less troubling measurements, such as cumulative emissions since the industrial revolution and per capita emissions. For example, the majority of countries in Asia fall well below the world average of 4.2 tonnes per year of per capita energy-related emissions (table 2.2) (IEA 2007). Though the gap between per capita emissions in the developing countries of Asia and the developed world is sizable, legitimate reservations have arisen over the prospects of it narrowing. At the heart of such reservations lies the realization that the climate change fight cannot be won without the formulation of effective climate policies in all regions including Asia. And though there is a lack of consensus over how to move toward an effective climate policy in Asia, there is broad agreement that it is in the best interest of Asia to seriously address this issue.

1.2. Climate change as a challenge for sustainable development in Asia

The adverse impacts of climate change on sustainable development pose one of the main reasons why Asian policymakers should consider climate change more seriously. On a global basis, severe adverse impacts were reported by the IPCC. On a regional basis, however, the IPCC reported fewer observations in Asia than in other regions. For example, there were 2,000 observed significant physical and biological changes attributable to climate change in Europe, but comparable numbers were 106 physical and 8 biological changes in Asia (IPCC 2007). This shortage of observed impacts seems to be partly due to the difficulties in downscaling global models to national and local contexts, and more importantly due to the limited capacity to conduct such research in Asia (Srinivasan 2006a).

Table 2.2. Energy-related CO₂ emissions by selected Asian countries in 2005

Country	Total CO ₂ Emissions (million tonnes)	CO ₂ /Pop. (tCO ₂ /capita)	CO ₂ /GDP (kg CO ₂ /2000\$)	CO ₂ /GDP (PPP) (kg CO ₂ /2000\$ PPP)
Cambodia	4	0.27	0.66	0.11
China, People's Republic of	5,060	3.88	2.68	0.65
China, Taiwan Republic of	261	11.41	0.73	0.46
China, Hong Kong	41	5.87	0.20	0.19
India	1,147	1.05	1.78	0.34
Indonesia	341	1.55	1.64	0.45
Japan	1,214	9.50	0.24	0.35
Korea, The Republic of	449	9.30	0.70	0.47
Korea, DPR of	73	3.26	6.97	1.98
Malaysia	138	5.45	1.23	0.56
Mongolia	10	3.44	7.75	2.01
Myanmar	11	0.22	0.73	0.15
Nepal	3	0.11	0.48	0.08
Pakistan	118	0.76	1.28	0.36
The Philippines	76	0.92	0.82	0.20
Singapore	43	9.93	0.38	0.38
Sri Lanka	12	0.63	0.62	0.15
Thailand	214	3.34	1.36	0.43
Vietnam	80	0.97	1.80	0.35

Source: IEA (2007); Note: PPP=purchasing power parity; kg=kilogram

A recent review of 186 studies confirmed that most of the region's ecosystems are highly vulnerable to climate change (Preston et al. 2006). Data reported between 1990 and 2005, for instance, showed that precipitation increased in North and Central Asia, but declined in South Asia. If these trends continue, reduced rainfall will drive down cereal production 30% by 2050 in South Asia, a region that can least afford food shortages (IPCC 2007). Increased warming can accelerate glacier melts in the Himalayas, initially heightening the risk of river basin and glacier lake outburst floods (GLOF)⁴ and then lowering freshwater availability in major river basins such as the Yangtze, Mekong, Yellow, Ganges, Indus, Brahmaputra, and Salween. Water shortage in these basins would threaten the livelihoods of millions by mid-century. Recent reports from China suggest a retreat of glaciers of up to 15% between 1964 and 1992.

Several other indirect impacts associated with climate change are projected to grow in scope and intensity. Warmer temperatures, for example, may degrade biologically diverse coastal and mangrove ecosystems in South and Southeast Asia, while increasingly variable rainfall could damage peat lands in Indonesia and Malaysia, which might further exacerbate climate change, as peat lands store large quantities of carbon⁵ and are already shrinking due to intensified land clearing practices. A drier climate may result in an increase in the number and intensity of forest fires in boreal North Asia, which would release more carbon into the atmosphere. Perhaps the most deleterious of these indirect impacts, though, are vector-borne diseases such as malaria and dengue that will spread with warmer temperatures and diarrhoea that will proliferate with more frequent droughts and floods (table 2.3).

Table 2.3. Key projected impacts of climate change in Asia

Sector	Projected Impacts
Agriculture/ Forestry	<ul style="list-style-type: none"> • Increased risk of hunger in South Asia due to a 30% decline in cereal yields (266 million Asians may face hunger by 2080) • Increase in agricultural water demand by 6-10% or more for every 1°C rise in temperature • Decline in net productivity of grasslands and milk yield • Increased frequency and intensity of pest outbreaks in forests & forest fires
Water	<ul style="list-style-type: none"> • Decline in water availability in India from ~1,820 m³/yr to ~1,140 m³/yr by 2050; may adversely affect >1 billion people. • Decline in annual flow of Mekong River by 16-24% by 2050 • Disappearance of Tibetan Plateau glaciers of <4 km length with a 3°C rise • Shrinkage of glacier area by 80% over the Tibetan plateau from 500,000 km² in 1995 to 100,000 km² by the 2030s. • Deterioration of water quality due to salt water intrusion • Decline in fish larvae abundance in coastal waters
Health	<ul style="list-style-type: none"> • Exacerbation of cholera in South Asia due to increases in water temperature • Increased endemic morbidity and mortality due to diarrhoea all over Asia caused by floods and droughts • Increase in infectious diseases for livestock
Coastal/ Marine ecosystems	<ul style="list-style-type: none"> • Loss of 2,500 km² mangroves in Asia with a 1 meter sea level rise • Flooding of Red (5,000 km²) and Mekong (15-20,000 km²) river deltas • About 2.6-18.8 million people along the coasts of Southeast Asia may be at risk of flooding by 2100 • Large scale inundation and recession of flat sandy beaches affecting tourism • Loss of ~30% of Asia's coral reefs in the next 30 years

Source: IPCC (2007)

Some impacts, such as increased water demand, will emerge gradually and offer affected areas time to adapt, but abrupt effects such as GLOFs will not and may prove more costly. The biggest threats for Asia are arguably the increasingly frequent and more intense extreme climate events (table 2.4). Between 1950 and 2004, for example, Asia experienced 157 windstorms, causing 1,380 deaths, affecting 2,496,808 people, and costing about \$5.9 billion (Preston et al. 2006). Heavy rainfall and seasonal typhoons mark much of coastal Asia's summer weather. A warmer climate can increase wind speeds of storms (Nordhaus 2006) that already level a costly toll on the region. The onset of heat waves would hit hardest those communities that lack the social and physical infrastructure to cope with prolonged stretches of extreme heat.⁶

Many parts of Asia will be vulnerable to yet another implication of climate change, sea level rise.⁷ Rising sea levels are likely to present a challenge to low-lying coastal cities such as Bangkok, Hong Kong, Karachi, Kolkata, Mumbai, Tokyo, and Shanghai. They are likely to be even more challenging in the densely populated mega-deltas located at the mouths of the Ganges-Brahmaputra and Pearl Rivers. Unfortunately, sea level rise is likely to be most serious in poverty-stricken regions such as coastal Bangladesh, Vietnam and small island developing states (SIDS) in the Pacific where a 1 to 5 metre increase (by 2100) could submerge large swaths of land, displace many thousands of people, and heighten the likelihood of socio-political conflict as climate refugees seek new livelihoods elsewhere (NEF 2007). For instance, a one meter sea level rise may affect more than 10% of Vietnam's population, the highest percentage among 84 countries surveyed (Dasgupta et al. 2007).

Table 2.4. Some examples of non-linear effects of climate change observed in selected countries of Asia

Extreme Events	Recent Evidence
Heat Waves	
China	Increase in frequency of short term heat waves, warmer days and nights
Japan & The Republic of Korea	Increase in days with maximum temperature above 35°C; decrease in days with extremely low temperatures
India	Temperature between 45°C and 49°C during the summer of 2003; temperatures that reached 49°C in Andhra Pradesh caused an estimated 1,000 deaths
Mongolia	Increase in duration of heat waves by 8-18 days; decrease in duration of cold waves by 13.3 days over the past four decades
Intense Rains and Floods	
Bangladesh	Serious and recurrent floods; floods in 1987, 1988, 1998 and 2002 were particularly devastating; most recent severe flood in August 2007
Cambodia	Floods in 2000
China	Increase in frequency of extreme rains in west and south China, and floods along the Yangtze River; more frequent floods in northeast China since the 1990s; more intense summer rains in east China; severe floods in 1998 along the Yangtze River and in the northeast
India	Serious and recurrent floods in northeastern states, most notably during 2002, 2003 and 2004; floods destroyed nearly all of West Bengal's roads and transportation infrastructure in 2000
Japan	Increase in frequency of extreme rains over the past century; serious flood in 2004 due to torrential rains from ten typhoons; significant increase in maximum rainfall between 1961 to 2000
Nepal	Serious and recurrent floods
The Philippines	Landslides and floods in 1990 and 2004
Sri Lanka	Serious floods in the southernmost province in 2003
Vietnam	Increase in extreme rain events and resulting flash floods
Cyclones and Typhoons	
China	Increase in number and intensity of strong cyclones since the 1950s; 21 extreme storm surges from 1950 to 2004; of the 21, 14 occurred between 1986 and 2004
Japan	Number of tropical storms peaked in the mid-1960s and again in the early 1990s; densely populated port cities are extremely susceptible to strong storms
The Philippines	Increase in the frequency of cyclones in the Philippines Area of Responsibility (PAR) between 1990 and 2003; on average, 20 cyclones cross PAR, of which, eight or nine reached land

Sources: IPCC (2007); Preston et al. (2006)

On balance, the impacts of climate change will be most severe in regions that are heavily dependent on climate-sensitive sectors, suffer from inadequate provisions of health care and public services, and lack resources to invest in safeguards from the impacts of climate change. Unfortunately, this characterization applies to much of Asia. Furthermore, there is an increasing fear that the current impacts of climate change in vulnerable communities may make it difficult for many Asian countries to achieve the millennium development goals (MDG) by 2015. For instance, Sperling (2003) and Reid and Alam (2005) argued that climate change can severely impede progress on MDGs as it may affect the sources of income for poor families, including water resources, forests and crop land, which may then lead to social tensions within a community and increased hunger. Likewise, climate change may limit opportunities for children to receive primary education, as reduced crop yields may force them to work and

increased risks of disease may weaken their health, both of which will keep children out of school.

1.3. The costs of action and inaction in Asia

Assessing the economics of action (costs and risks of mitigation and adaptation policies) and inaction (costs and risks of impacts) of climate change is a huge challenge, as the outcomes of modelling are affected by several assumptions on the stabilization target and level; the emissions baseline, related technological change and resulting emissions; the discount rate; and the portfolio of technologies. The results would also be different if one considers long-term hidden costs. Indeed many earlier studies (Nordhaus 1991) overlooked non-market impacts such as effects on human health and ecological services. The most thorough analysis to date of the costs and risks of climate change revealed that a loss of up to 3% of global gross domestic product (GDP) might occur with a temperature rise of 2-3°C above pre-industrial levels (Stern 2007). However, if direct impacts on human health are considered, costs could rise to 5-10% of global GDP. Amplifying feedbacks in the climate system could raise temperatures further and boost losses to 7-14% of global GDP. Finally, additional weighting for impoverished areas could raise the figure closer to 20% of global GDP. The UNFCCC (2007) estimated current global losses from climate change within the range of \$160-330 billion, which are projected to increase to \$850-1,350 billion by 2030.

On the other hand, the costs of action on a global basis are relatively low. Stern (2007) noted that the stabilization of emissions at the 550 parts per million (ppm) carbon dioxide equivalent (CO₂e)—the level that is likely to keep temperatures within 2-3°C increase—would require expenditures in the range of only 1% of global GDP by 2050. IPCC (2007) reported that the global average cost of stabilizing GHG levels at 445-710 ppm ranges from less than 3% to a gain of 0.6% by the year 2030, which translates into an annual reduction in the GDP growth rate of less than 0.12% to less than 0.06%. A recent UNFCCC report indicated that additional financial flows of \$200-210 billion will be necessary for GHG mitigation in 2030 to return global emissions to current levels (UNFCCC 2007). The World Bank (2006) estimated that costs of adaptation in developing countries alone would be around \$9-41 billion per year. The costs of adaptation will increase further as mitigation action is delayed.

Although much of Asia is vulnerable to rising temperatures, varying precipitation patterns and rising sea levels, limited work has been done to assess the costs of action and inaction. Indeed this is one area that deserves urgent attention by researchers and policy makers. In Malaysia, for example, the initial national communication (NC) to UNFCCC estimated that a 1°C rise in ambient temperature would cause a loss of about \$12.4 million per year for the generation of 6,600 MW electricity due to a reduction in power output by 2% (table 2.5). Economic losses from sea level rise in the Krawang and Subang districts of Indonesia were estimated at \$0.5 billion (PEACE 2007). A recent study in Indonesia projected a huge economic loss of \$25.5 billion due to sea level rise by 2100, considering a loss of 90,260 km² with an estimated land value of \$0.28 million per km² (Susandi et al. 2008). In China, losses from a 100 year high water tide were estimated to be \$4.8 billion while costs of action were estimated to be \$400 million. Paying for preventive action would therefore result in a net benefit of \$4.4 billion (Hay and Mimura 2005). Stern (2007) reported that costs in India and Southeast Asia could range from 2.5 to 3.5% of annual GDP. The high end figure corresponds to

estimates that consider amplifying feedbacks that increase temperatures from 3.9°C to 4.3°C above pre-industrial levels. If weights are added for poorer regions, unpredictable non-linear effects and unabated emissions (which raise temperatures), then the respective loss estimates are expected to rise to 9-13% of annual GDP by 2100 (table 2.6). In view of the paucity of reliable estimates in Asia, some efforts are underway by the Asian Development Bank (ADB) and others to conduct Stern-review type studies in China and Southeast Asia. There is a further need to develop the capacity to use integrated assessment models that can evaluate these costs in developing Asia.

Table 2.5. Costs of climate change impacts in electricity sector in Malaysia

Climate change	Impact	Unit cost of impact	Estimated cost of impact	Adaptation /Mitigation
For every 1°C rise in ambient air temperature	Loss in gas turbine power output by 2%	Loss of RM0.67 million per year per 110 MW gas turbine	About RM40 million per year for 6,600 MW capacity	Air intake cooling
	Loss of 2% of power output by hydro-turbines	Loss of RM0.9 million per year per 100 MW hydro-turbine	About RM18 million per year for 2,000 MW capacity	Precipitation enhancement
For every 1°C rise in water temperature	Loss of 8% of power output by stream turbines	Loss of RM2.6 million per year per 110 MW steam turbine	About RM95 million per year for 4,000 MW capacity	Air cooled condensers
1m rise in sea level	Erosion of beaches fronting power station	Specific to a few stations. Currently RM2 million is spent annually to mitigate erosion problems at each station affected by coastal erosion.		Wave breakwaters Relocation of power plants
	Corrosion	RM3 million per year per station	RM18 million per year for six stations	Cathodic protection, painting

Source: Ministry of Science, Technology and the Environment, Malaysia. 2000. Note: RM: Malaysian Ringgit

Table 2.6. Projections of costs of climate change impacts in India and Southeast Asia by 2100

	Estimates that <u>do not</u> capture the full range of costs			Estimates that capture the full range of costs ⁸		
	Loss in GDP	Additional people living on less than \$2/ day/ year	Additional child deaths / year	Loss in GDP	Additional people living on less than \$2/ day/ year	Additional child deaths / year
Temperature increase of 3.9°C	2.5%	24 million ⁹	40,000	9%	100 million	165,000
Temperature increase of 4.3°C ¹⁰	3.5%	34 million ¹¹	60,000	13%	150 million	250,000

Source: Stern (2007)

The above reports suggest that the costs of inaction would exceed the costs of action by several times. However, crafting an effective strategy to cope with climate change is not easy, as there are many uncertainties on the impacts and costs of action and inaction at the local level. The complexity is further compounded by the need to meet immediate developmental challenges such as the provision of access to energy. However, inaction because of either uncertainty or developmental needs is not an option either, as failure to address climate change may undo the development achieved to date. The best way to move forward is with concerted action that is based on the precautionary principle and which identifies “no-regrets” and “win-win” options¹². In this context, the Bali Action Plan from COP13 is significant as it calls for measurable, reportable and verifiable actions by all countries.

There is another reason why Asia can and should address climate change and development in a more proactive and integrated manner. Asia is expected to build much of the infrastructure needed to accommodate its rapid economic growth in the near future, and most of the infrastructure is likely to remain for several decades. Therefore, it is essential to avoid a “lock-in” of outdated carbon-intensive technologies. There is also an urgent need to pursue a developmental path which is based on low carbon, resource efficient and qualitatively different practices and which offers improvements in the quality of life and does not negate the right to development. The design and implementation of developmental policies that duly consider climate change will be more effective, therefore, than treating climate change policies in isolation. Pulling off this transition, however, requires an informed appreciation for where Asia stands now, and concrete recommendations for where it should go in the future.

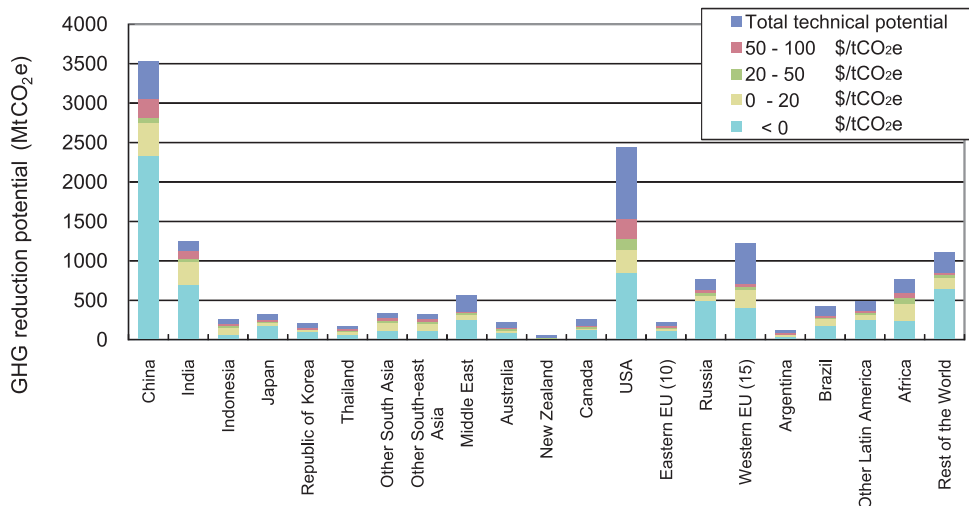
The aim of this chapter is to objectively assess potential opportunities (section 2) and barriers (section 3) for aligning climate change actions and sustainable development strategies, and then identify a few priorities (section 4) by which Asia can contribute to effective global action. The hypothesis is that development in Asia can be made more sustainable and climate-resilient if policymakers proactively integrate climate concerns into development strategies at all levels.

2. The good news: cost-effective climate actions

Though crafting effective climate policies will be challenging in Asia, the challenge may be manageable if attention is paid first to exploiting low cost mitigation and adaptation possibilities. The IPCC (2007) confirmed that mitigation options with net negative costs have the potential to reduce annual emissions in 2030 by around 6 GtCO₂e, accounting for about 10% of projected global emissions and that developing countries have greater mitigation potential than industrialised countries. Another study revealed that it would be technically possible to abate 26.7 GtCO₂e by 2030 with measures costing less than €40 per tonne and that more than half of such abatement possibilities are located in developing countries (Enkvist et al. 2007). Three reasons account for such a high prevalence of low cost abatement options in developing economies – high populations, the lower cost of abating new growth as opposed to reducing existing emissions, and high potential for reducing emissions from deforestation (which accounts for nearly 20% of global emissions). A recent study confirmed that Asian countries offer several cost-effective GHG mitigation options (fig. 2.1) (Hanaoka et al. 2008).

The opportunities also stem from the effective integration of climate and development policies. The international community has long recognised the need for integrating climate concerns in national development planning. Article 3 of the UNFCCC states that “policies and measures to protect the climate system against human-induced change... should be integrated with national development programmes.” National development planning can therefore work as a tipping point, enabling climate concerns and development objectives to be addressed simultaneously. The IPCC (2007) further supports this claim by stating that “it is very likely that significant synergies can be exploited in bringing climate change to the development community, and critical development issues to the climate-change community.”

Figure 2.1. GHG mitigation potentials in 2020



Source: Hanaoka et al. (2008)

2.1. Energy efficiency and renewable energy

Improving energy efficiency (EE) is among the most cost-effective mitigation options available to Asia. For instance, increases in GHG emissions between 2000 and 2020 could be halved if only 20% of energy was saved by using current technologies more efficiently in existing industrial and power facilities in Asia (METI 2004). Many potential EE opportunities are located in China, the source of 80% of Asia’s industrial growth over the past 25 years (IEA 2007). Steel production in China, for example, is four times less efficient than in Germany (Kraemer et al. 2007). Some models suggest China may have the world’s largest technical emission reduction potential of approximately 3.5 GtCO₂e by 2020 (Hanaoka et al. 2008). In India too, modelling studies revealed an abatement potential of 5 GtCO₂e between 2005 and 2035 from energy options at prices below \$10 per tonne of carbon equivalent (Sathaye et al. 2006).

These opportunities are not exclusive to China and India. Many countries in Asia have announced ambitious plans to construct energy facilities over the next 20 to 30 years. Because these facilities will not be retired prematurely, equipping them with low carbon technologies could dramatically reduce future emissions and mitigation costs. Modal

shifts and better urban planning offer similar low-cost mitigation opportunities in the transportation sector. Removing barriers to hidden efficiencies in the residential and commercial building sector could further save mitigation costs (IEA 2006). These measures will be important because many countries in Asia have yet to construct the majority of their building, transportation, and energy infrastructure.

An encouraging sign is that many countries in Asia have taken steps in this direction. For example, China's 11th Five Year Plan includes an ambitious 20% EE improvement target (The People's Republic of China 2006). The target was based on the 2004 National Development and Reform Commission's (NDRC) mid-term energy conservation plan that aimed to reach 1990 international EE levels by 2010 and catch up with international levels by 2020. If China can attain this goal, it would be equivalent to the world's largest CO₂ mitigation action. To achieve the goal, China initiated a number of special programmes such as "top 1000 enterprise energy action plan", "EE labelling mechanism" and "EE standards for products from major energy consuming sectors" (He 2006). Similarly encouraging is Japan's rich experience with EE and its "top runner" standards (see chapter 9). Both the experience and standards might prove instructive to other Asian countries. Recognising the importance of EE in GHG mitigation, Japan announced at the World Economic Forum in January 2008 the goal of improving global EE by 30% by 2020 through a five-year \$10 billion aid package called "Cool Earth Partnership."

Improving EE is not the only cost-effective GHG mitigation opportunity available to Asia. GHG emissions can be reduced by introducing renewable energy (RE), which has considerable potential in the region. For example, the technical potential for solar photovoltaics (PV) across Asia is estimated to be around 860,000 TWh/year (de Vries et al. 2006). The recent increases in global oil prices and concerns over energy security have forced Asian countries to look at RE options more seriously than before. Another reason that RE may be desirable is that many rural areas in Asia are not connected to well-established power grids. These areas could benefit from standalone RE applications and "mini-grid" applications, which are cost-effective compared with grid extension. Such standalone RE applications would also afford poor communities in rural areas important benefits in terms of adaptation to climate change (through creating economic opportunities, widening the access to water resources, and decreasing urban migration).

It is against this backdrop that many countries in Asia have established RE institutions, set RE targets, and initiated RE deployment policies (both market pull approaches and technology push policies) in electricity, heating/cooling, and transportation. In India, a Ministry of Non-Conventional Energy Sources (renamed in 2006 as the Ministry of New and Renewable Energy) was created in 1992. The Ministry has launched research and development (R&D) programmes and helped engineer a shift from subsidy-driven dissemination initiatives to the commercialization of low carbon technologies. The Ministry also helped set a goal of using RE for 10% of new power generating capacity by 2010. India's policies (e.g. preferential tariffs, fiscal incentives such as accelerated depreciation, RE portfolio standards) to develop wind and solar power are now widely recognised to hold the potential to be replicated in other parts of Asia. China announced a RE law in 2005 that seeks to raise the share of RE to 15% by 2020.¹³ Indeed solar water heating in China is now considered a successful model to be followed by other Asian countries. Indonesia, Japan, Malaysia, the Republic of Korea, Singapore, Thailand, and the Philippines have adopted similar RE policies and targets

(Srinivasan 2006b). For example, Indonesia and the Philippines launched special efforts to support independent power producers (IPP) through tax subsidies, investment and RE power purchase and price assurance policies. Investment in biofuels is growing rapidly in many countries (see chapter 5). China, India, Malaysia, the Philippines and Thailand have adopted ethanol blending mandates for transportation either at the provincial or national level and considerable scope exists to expand this option. Likewise, the opportunities for using biomass for district heating and combined heat and power are enormous in many parts of Asia.

Arguably the most encouraging sign is that Asia's private sector is becoming more interested in EE and RE investments. This involvement is demonstrated by the growing number of CDM projects in Asia. Out of 1035 approved CDM projects as of 1 May 2008, more than half are located in Asia. Similarly encouraging are emerging attitude and lifestyle changes. In Japan, for example, the Ministry of the Environment launched “cool biz” and “warm biz” campaigns that led to considerable emission reductions.

The opportunities for regional cooperation in the generation and utilization of electricity (based on RE such as hydropower) are great in Asia. Successful examples of cooperation, such as the transboundary power trade agreement between countries of the Greater Mekong Sub-region, have the potential to be replicated in other regions. Such transboundary agreements can accelerate collective efforts to build large hydropower stations, establish regional grids and enter into long term purchase contracts.

2.2. Opportunities outside the energy sector

Outside the energy sector, non-climate policies (agriculture, forestry, water, waste, trade, poverty alleviation, population control) offer significant opportunities for cost-effective mitigation in Asia. Chapters 4-7 cover some of these possibilities in detail. In this chapter, it merits underlining that there is a growing recognition that the UNFCCC's “climate-policy track” alone is unlikely to deliver sufficient emission reductions and a “non-climate policy track” will be needed (Kok and de Coninck 2004). This non-climate track would entail incorporating co-benefits into policy decisions and exploiting synergies with other MEAs. It also suggests opportunities for embedding climate change policies in sustainable development plans.

Asian policymakers should pay attention to the non-climate policy track mainly because of the low costs of mitigation through such approaches. The costs can be even lower when co-benefits such as increased energy security, reduced energy costs, and reduced impacts of air pollution on health are included (Vennemo et al. 2006). Transportation (box 2.2), waste management, energy, water, buildings and agriculture sectors provide opportunities to integrate development and climate concerns and generate substantial co-benefits. Co-benefits can also be realised from reducing methane emissions from natural gas and oil infrastructure in China, India and Thailand (Fernandez et al. 2004). For all these reasons, the Ministry of the Environment in Japan (MoEJ) has initiated a project to identify good practices in various non-energy sectors that generate climate benefits. In April 2008, the MoEJ launched the Asia-Pacific Gateway on Climate and Development (a web-based platform for sharing experiences and information on “co-benefits” activities, and on adaptation actions) in collaboration with the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

Box 2.2. Co-benefits in the transportation sector, Hyderabad, India

Many Asian cities have experienced rapid economic growth but public infrastructure has not grown accordingly. The combination of rapid urbanization and motorization has degraded the urban environment. Transportation policies often overlap with climate mitigation policies, which mean that transportation holds great potential for realizing co-benefits.

The United States Environment Protection Agency's (USEPA) Integrated Environmental Strategies (IES) project in the metropolitan area of Hyderabad, India focused on analysing co-benefits of transportation policies that would simultaneously reduce GHG emissions and improve local air quality. Transport sector policies related to a more effective public bus transit system were analysed including (i) dedicated bus lanes; (ii) priority for buses at stoplights and intersections; (iii) route rationalization; and (iv) transition to compressed natural gas (CNG) buses.

The study estimated that by 2021 there would be a 46% reduction in CO₂ emissions compared to the baseline scenario, while the resulting co-benefits would be 29,096 fewer deaths, 17,401 fewer hospital admissions for cardiovascular diseases, and reduced hospital admissions for respiratory symptoms. These co-benefits were valued at \$50 million (the lowest estimate), taking into account only health benefits in the metropolitan area. If the same policies were adopted in other cities or non-health co-benefits were included, such as increased energy security and enhanced technological development, the benefits would be much higher.

Source: IES (2005)

Another possibility for the non-climate policy track is linking climate and development in cross-MEA implementation. The Convention on Biological Diversity (CBD), which emphasises species preservation, and the UN Convention to Combat Desertification (UNCCD), which focuses on sustainable land development, offer several potential cross-agreement synergies. Exploiting these synergies would reverse unsustainable land use practices, conserve biodiversity, protect ecosystem services, improve local community livelihoods, and deliver climate benefits. A concrete example of these synergies is the decision in September 2007 by Parties to the Montreal Protocol to an accelerated freeze and phase-out of hydrochlorofluorocarbons (HCFC), known for their significant contribution to climate change. The freezing of production of HCFCs by developing countries in 2013 and pushing up their final phase-out date by ten years to 2030 could result in a reduction of GHG emissions up to five times greater than the reduction that the Kyoto Protocol would achieve during its first commitment period.¹⁴

2.3. Development-friendly adaptation

As the world is already committed to a certain amount of global warming and the impacts of climate change are increasingly evident, adaptation policies and measures are crucial (UNEP 2007). In the future, Asian policymakers must pay equal attention to adaptation and mitigation. Just like mitigation, the high costs of adaptation present a hurdle. Fortunately, these costs can be reduced if adaptation measures are integrated

into sectoral and national development plans. Since virtually no sector will be excluded from the impacts of climate change, it is essential to ensure that adaptation concerns are built into development planning in all sectors.

In mainstreaming adaptation concerns into sectoral planning, however, it is important to fully utilise time-tested local coping strategies. Many communities in developing Asia have accumulated local knowledge to cope with weather-related disasters. While such strategies alone may be unable to cope with all impacts, opportunities for incorporating local knowledge into improved adaptation options are considerable in Asia.

Significant synergies exist between local adaptation activities and official development assistance (ODA) initiatives. The Japan International Cooperation Agency (JICA), for example, is undertaking research on a comprehensive flood mitigation project in Cavite Province in the Philippines (JICA 2007), which suffers frequent flooding from three rivers and high tides. The design of flood control measures in this project is being modified to cope with the possible impacts of climate change, such as a greater likelihood of more frequent floods because of sea level rise. It may be possible to apply the model used in Cavite Province to other vulnerable parts of Asia.

From a sustainable development perspective, risk management efforts have proven far more cost-effective than repairing future damage. More generally, it would be useful to align ODA, development finance, and country development funds in support of successful local coping strategies. Greater coordination between external funding and local policies could pay multiple dividends for communities and further reduce the costs of adaptation in Asia.

In conclusion, Asia offers considerable potential to undertake many cost-effective climate actions. Realizing this potential is, however, another matter. As section 3 will show, there are as many challenges as opportunities for Asia.

3. The bad news: climate policy challenges

Despite the considerable potential for cost-effective climate actions in Asia, there are signs that this potential may go unrealised. Climate change has not become the policy priority one might expect in Asia, and progress in integrating climate and development policies remains inadequate. Another area where change could be beneficial is the reactive (as opposed to proactive) stance that much of Asia has taken in international climate discussions. This section outlines such challenges before suggesting how they may be transformed into opportunities.

3.1. Climate change: A low order priority

For many years, climate policy was given less attention in Asia than other regions. In recent years, Asia's growth in GHG emissions and the region's vulnerability to climate change has drawn considerable media attention to the issue. However, many senior officials and politicians still treat climate policy as a low priority, though climate change will make it difficult for many countries in Asia to alleviate poverty and fulfil the MDGs.

There are numerous reasons for the limited attention. Limited understanding of the costs of action and inaction is partially to blame. Continued scientific uncertainties on local and national impacts are also partially at fault. Lack of knowledge on ways to decouple economic growth and energy consumption is another barrier. But most telling is that policymakers in developing countries of Asia prefer to meet basic developmental needs before addressing climate issues (IGES 2005; Srinivasan 2006a). To illustrate, large rural populations in Asia lack access to modern energy sources (e.g. nearly 54% of Indians lack access to electricity). Since there is a strong correlation between economic development (GDP) and energy consumption (Feinstein 2002; Modi et al. 2005), policymakers want to ensure these populations have access to reliable electricity. Many of the current sources of dependable energy (e.g. coal-fired power plants), however, will increase GHG emissions. Policymakers do not want to risk pursuing more innovative energy options that may turn out to be unreliable.

At a fundamental level, the reason climate issues are subordinated to development issues is perceived tradeoffs between economic development and climate actions (which is partly related to an institutional separation of climate change and development officials and their clientele, as discussed in chapter 8). A result of this view (and institutional separation) has been a lack of expertise in developing policies that integrate climate and development actions. This is apparent in the difficulties in designing measures to capture win-win opportunities such as improving energy end-use efficiency in commercial and residential buildings, and integrating climate policies and sustainable management practices in agriculture and forestry.

The relatively low status accorded to climate change is also related to natural resource endowments. India has large coal reserves (estimated to be about 234 billion tonnes (t) in 2002) and therefore has a carbon-intensive energy system. China also has a carbon-intensive energy structure, with coal accounting for 66-75% of primary energy consumption from 1980 to 2006. The reversal of policies to improve energy security, such as switching from oil to coal in Indonesia and Vietnam, and from forest protection to deforestation to grow biofuels in Malaysia and Indonesia, are similar illustrations of how easily exploited natural resource endowments can increase GHG emissions. For example, Indonesia's energy policy to rapidly expand coal-fired power generation will increase GHG emissions from coal burning by 20 times between 2005 and 2025 (PEACE 2007). Vested interests that support these unsustainable practices play an equally important role in keeping climate change below other issues on many policymakers' list of priorities. Another reason that climate change has yet to move up the list is that many policymakers in Asia consider it purely an environmental rather than a developmental issue. The limited influence of environmental ministries on developmental issues, which are usually under the control of more influential ministries, like finance and planning, continues to pose a barrier to enhancing the status of climate change in many countries.

3.2. Policy rhetoric and reality

The attention to climate change issues notwithstanding, many countries in Asia have introduced policies that indirectly affect GHG mitigation and adaptation (Chandler et al. 2002). Such policies are often enacted with a view to either address national concerns such as energy diversification and transportation management, or to meet international obligations to realise benefits from the global climate regime (table 2.7). While many countries have formulated policies and created new institutions (see chapter 8), in several cases these

measures and organisations have not performed as well as hoped. In fact, difficulties in implementing policies have often resulted in gaps between policy rhetoric and reality.

Some of these gaps can be found in the mitigation options discussed in section 2. For example, the 11th five-year plan of China seeks to reduce energy intensity by 20% per unit of GDP over the 2006-2010 period, which equates to 4.36% per year. However, energy intensity reduced by only 1.33% (Yang 2008) and 3.27% in 2006 and 2007 respectively. Likewise, India's ministry for promoting RE sources has struggled to transform the country's carbon-intensive energy structure. Elsewhere in Asia similar difficulties have been observed in the attainment of RE targets (e.g. the Philippines, Indonesia, Sri Lanka, and Thailand, among others) and utilization of alternate fuels (CNG, biogas, biofuels). An assessment of the installed RE capacity and technical potential in Asia found that only a fraction of capacity has been tapped to date. For example, the installed capacity of wind power in China and India is estimated at 0.1% and 11.9% of their potential, respectively. Similarly, biomass utilization in Indonesia and India is 0.9% and 1.76% of their potential (USAID 2007). Energy market distortions, legal and regulatory barriers, and institutional constraints led to widening the gaps between rhetoric and reality in RE policies in several countries.

Table 2.7. Institutional arrangements to address climate change in Asia

Country	Selected institutional arrangements, policies and measures
Cambodia	Creation of a national climate change committee; submission of a national adaptation programme of action (NAPA)
China	Mandatory EE standards for building construction through the promulgation of the Designing Standard for Energy Conservation in Civil Buildings (2006); establishment of a national leading group headed by Premier Wen Jiabao; announcement of a national climate change programme
India	Establishment of the Bureau of Energy Efficiency; RE targets; Establishment of a National Climate Change Committee
Indonesia	Climate Change National Action Plan of 2007; National Energy Policy 2005; Issuance of regulations regarding the national energy mix, EE, biofuels, etc.
Japan	Enactment of laws, including a three-stage approach, to promote global warming prevention activities to achieve the Kyoto targets
Lao PDR	Establishment of a Climate Change Steering Committee
Malaysia	Creation of a National Climate Change Committee, RE targets, and tax incentives for EE; mainstreaming EE in development plans
Maldives	Creation of the Ministry of Environment, Energy and Water; establishment of the National Energy Authority to undertake energy resource assessment to estimate the potential of RE
Mongolia	National programme on RE (2005)
Myanmar	Establishment of a National Commission for Environmental Affairs; promotion of the use of CNG, biogas and biofuels; implementation of greening projects in 13 sub-divisions of the country
The Philippines	Presidential Task Force on Climate Change in 2007; The Philippines energy plan focusing on policies for RE, EE, development of alternate fuels
The Republic of Korea	Third National Action Plan specifying 90 tasks for GHG mitigation
Singapore	National climate change strategy; EE programme office and master plan; co-funding of energy audits for industries; building efficiency standards, labels, and green vehicle rebates
Sri Lanka	Establishment of designated national authority (DNA) and development of national CDM policy framework; integration of CDM potential in National Energy Policy; setting a target that at least 10% of new energy should be from renewable sources
Thailand	Establishment of the National Board on Climate Change Policy and Thailand Greenhouse Gas Management Organization (TGO); Energy Strategy Plan of 2005 and promotion of RE under CDM

A brief review of current efforts points to similar gaps in adaptation policies. For example, NCs submitted to the UNFCCC reveal limited attention to adaptation (table 2.8). Few countries have national policy frameworks for adaptation. The measures to date largely include policy documents such as national adaptation programmes of action (NAPA) by least developed countries (LDC), disaster management plans, and enhanced research on adaptation in agriculture. The limited amount of attention devoted to adaptation is cause for concern given Asia's susceptibility to climate impacts.¹⁵

Table 2.8. Coverage of adaptation policies and measures in latest Asian National Communications

Country	Total number of pages	No. of pages describing impacts and vulnerability	No. of pages discussing adaptation policies
Bhutan	63	10	2
Cambodia	79	8	2
China	112	13	4
India	292	48	8
Indonesia	116	10	3
Japan	314	11	0.5
Lao PDR	97	two lines	one line
Malaysia	131	30	7
Maldives	134	30	10
Mongolia	106	18	7
Nepal	181	41	10
Pakistan	92	14	9
Papua New Guinea	83	20	6
The Republic of Korea	132	8	2
Singapore	75	5	one line
Sri Lanka	122	12	5
Thailand	100	15	2.5
The Philippines	107	20	12
Vietnam	135	17	4

Sources: National Communications submitted to UNFCCC

Similar gaps were also evident in implementing the Kyoto Protocol. Such gaps might be expected given that the first commitment period of the Kyoto Protocol had a very short timescale, modest emission reduction targets, and little consideration of adaptation (box 2.3). Gaps were also found in the implementation of CDM, a unique flexibility mechanism designed to offer developed countries low-cost mitigation opportunities while contributing to sustainable development in developing countries. Many Asian countries expected to benefit from the CDM, and established designated national authorities (DNA) to oversee the implementation of CDM projects. As of 1 June 2008, most of the UNFCCC Non-Annex I countries in Asia had established a DNA. However, many countries have yet to take full advantage of CDM. For example, Indonesia has the potential to develop CDM projects that could generate 235 million certified emissions reductions (CER) by 2012, but only 12 projects with a potential to generate 13 million CERs by 2012 were registered

to date (PEACE 2007; UNEP-RISO 2008). The mechanism's high expectations for technology transfer and finance have also yet to materialise in most countries. The lacklustre performance of CDM in terms of geographic equity and contribution to sustainable development is discussed in section 4.3.

Box 2.3. A critique of the Kyoto Protocol and its environmental effectiveness

The Kyoto Protocol was adopted on 10 December 1997 but only came into effect on 18 February 2005. It requires participating countries to reduce collectively GHG emissions by 5.2% compared to 1990 levels. So far it has produced no demonstrable reductions in emissions worldwide or even in anticipated emissions growth. For example, the most recent official projections for Annex B emissions in 2012 show that total emissions are likely to be at least 8% above 1990 levels. Several features of the Protocol have been criticised, including its focus on binding targets, which were decided without a careful analysis of each country's circumstances and incentives necessary for effective engagement, its limited effect in stimulating the development of low carbon technologies, its inability to achieve universal participation, poor design of its institutions to enforce the adopted targets, etc. On the positive side, the Protocol did create market-oriented institutions and rules—including international emissions trading, broad coverage of emissions sources and sinks, and some temporal flexibility in complying with emissions commitments—that will promote cost-effective attainment of emission reduction goals. It also created the architecture for an international regime that is likely to last for centuries and galvanised actions at sub-national levels in countries that did not ratify the Protocol. Most importantly, it helped set a price on carbon.

While the intentions at the time of adoption were laudable, the effectiveness of Protocol was gradually weakened over time through negotiations and rejection by some nations in 2001. The US withdrawal may have had the greatest impact in reducing its environmental effectiveness. In order to get many countries on board, major concessions (e.g. through inclusion of sinks) were made. The exclusion of sources such as international aviation, maritime transport, and deforestation is also seen as contributing to its reduced environmental effectiveness. There is a growing concern that the Protocol exposes participating countries to enormous costs, and that many firms and sources of GHG emissions that come under the Protocol could simply move their production to countries that are not yet covered. Possibly, an excessive focus on the Protocol has stifled discussion of alternative policy approaches. The Protocol was modelled on the Montreal Protocol but addressing climate change involves a far greater range of issues. Notwithstanding these concerns, the Protocol remains the only international legal instrument designed to lead the world towards GHG reductions needed to avoid the catastrophic impacts of climate change.

3.3. Asia's reactive stance in international climate negotiations

In addition to the gaps between rhetoric and reality, a related concern is Asia's largely reactive stance in international climate negotiations. Over the past three years, IGES has held a series of multi-stakeholder consultations on the post-2012 climate regime. A

recurring theme from these meetings is that Asia's influence on international climate negotiations has not been as proactive as might be expected given its contribution and vulnerability to climate change (IGES 2005; Srinivasan 2006a; Srinivasan 2008).

Deep divisions within the G77+China group of countries contributed to the difficulties in crafting a sound regional policy for a post-2012 climate regime. Most countries in the region, including large industrializing countries such as China and India and Annex I countries such as Japan, have yet to declare a position on the post-2012 climate regime. While Japan recently announced an ambitious plan to halve global emissions by 2050, the plan's implementation details or its implications for emissions from Asia's developing countries have yet to be released.

Some countries have initiated efforts to discuss the post-2012 climate regime. For example, Cambodia has begun discussions on the post-2012 regime at the technical and policy levels, while Indonesia has established a special working group to consider post-2012 issues. Most countries in the region, however, have adopted a "wait and see" approach. In many of these countries, uncertainty over the positions of Annex I parties and the lack of capable staff and funding in concerned ministries have slowed down progress in formulating a post-2012 position at the national level. In addition, the limited negotiation capacity of policymakers to reflect their concerns and aspirations presents a problem. The absence of a regional platform for developing a common position among Asian countries and inadequate coordination between various ministries, government officials and other stakeholders are also impediments.

Other barriers revealed in the consultations include the limited awareness of global negotiation issues by Asian policymakers and the private sector, limited attention by the national media to the implications of regime discussions on national policies, and a lack of technical capacity. In some countries (e.g. the Philippines and the Cook Islands), insufficient funds to address climate change issues made it difficult to attend international negotiations and engage in informed discussions on the future climate regime.

Formal processes to build a national consensus on the post-2012 regime have not been initiated in most countries but informal discussions have occurred. Non-governmental organisations (NGO) and academic institutions have coordinated many of these efforts, often with indirect support from advisory panels to the national governments. For example, informal discussions with businesses and industries are ongoing on a limited basis in India, Japan, Malaysia, and Thailand. Meanwhile, inter-ministerial meetings, which are usually held in connection with CDM approval processes at DNAs, have apparently facilitated understanding of post-2012 issues in China, India, Indonesia, the Republic of Korea, the Philippines and Vietnam. But discussions with key stakeholders on post-2012 climate regime issues have yet to begin in Bangladesh, Bhutan, Cambodia, Lao PDR, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Singapore, and Sri Lanka (Srinivasan 2006a).

3.4. Reversing current trends

Climate policy will remain a challenge in Asia if current trends continue. Indeed several technical, institutional, financial and capacity issues have delayed efforts to integrate climate concerns in development planning throughout the region. In view of the growing evidence that the costs of action would be lower than inaction, Asia must take

advantage of cost-effective climate actions and mainstream climate change concerns into ongoing sustainable development planning.

Since the world is already committed to a certain level of increased temperatures and rising sea levels, and mitigation efforts from developed countries alone will not suffice, Asia cannot afford to “wait and see” or follow the unsustainable development paths of industrialised countries. Instead, Asia should flip the historical energy model and bring about a decisive shift in development patterns through greater efficiency, decarbonisation, and socio-economic restructuring based on innovation and entrepreneurial problem solving. Long-term and predictable policy support to institutionalise such changes is also crucial. Section 4 focuses on four priorities for action in this direction.

4. Four priorities towards a low-carbon, climate-resilient Asia

All countries in Asia share a common goal of realising sustainable development and have developed many strategies to achieve that goal. Realising the vision of a low-carbon, climate-resilient society within the framework of sustainable development will require Asia to play a proactive and constructive role in (i) building a fair, effective, and flexible post-2012 climate regime; (ii) enhancing the region’s adaptive capacity; (iii) utilizing market mechanisms more effectively; and (iv) building a low carbon society and exploiting developmental co-benefits.

4.1. The post-2012 climate regime

Climate change is a global phenomenon that requires a global response. Although developing Asia’s historical contribution to climate change has been far below that of industrialised countries, its emissions are projected to increase sharply in the near future. It is therefore imperative that all countries act soon and together. The basis for action should be widely accepted principles in most MEAs and the current climate regime: common but differentiated responsibilities, the polluter pays principle, and precautionary approaches. The immediate priority should be to design a post-2012 regime that reconciles global climate objectives with Asian developmental priorities.

Designing such a framework will require effectively engaging Asian policymakers and other stakeholders. During previous international climate discussions, many countries in Asia failed to fully articulate their concerns and interests. The reasons for these failures include a lack of recognition of the linkages between climate change and sustainable development, fear of additional costs, insufficiency in international assistance to address climate change, and poor institutional and human capacities. Given the result of these failures—a regime that does not adequately reflect the interests of the world’s rapidly growing economies—it is crucial that Asia’s concerns and aspirations be incorporated in future negotiations.

4.1.1. Findings from IGES consultations

IGES consultations over the past three years revealed that many countries in Asia share concerns about energy security and economic growth, market mechanisms, technology, adaptation, finance and institutional and human capacity. Moreover, there

was a general agreement that future regime negotiations should (i) consider climate concerns in the broader context of sustainable development; (ii) streamline the CDM by reducing its complexities and uncertainties; (iii) place a greater emphasis on adaptation by building on existing funding mechanisms; (iv) facilitate the development, deployment and diffusion of climate-friendly technologies; and (v) provide further support to strengthen the capacity of negotiators, the private sector and financial institutions in the region. However, cross-national differences also existed on (i) ways to consider equity in the future climate regime; (ii) form, time and kind of involvement of developing countries; (iii) national preferences for climate-friendly technologies; and (iv) approaches and funding for adaptation, especially regarding the need for a separate adaptation protocol and the introduction of market-based mechanisms.

During the consultations, participants expressed several Asia-specific interests and priorities relevant to key elements of the post-2012 climate regime. The most salient remarks and recommendations are summarised below. For additional details, readers are encouraged to refer to IGES (2005), Srinivasan (2006a) and Srinivasan (2008).

(i) Future regime design and its implications

Asian stakeholders emphasised that the Kyoto Protocol must be the basis for the future climate regime, since much time and effort has already been invested in developing the global framework. All other initiatives must complement efforts taken under the Kyoto Protocol. In view of the IPCC findings on the need for global emissions to peak by 2015 to limit global temperature rises to 2-2.4°C over pre-industrial times, participants stressed that industrialised countries should take the lead in setting ambitious GHG mitigation targets and show demonstrable progress in implementing their current commitments under the Kyoto Protocol. Stern (2008) suggested that developed countries should commit to cutting emissions by 80-90% from 1990 levels by 2050 together with credible interim targets.

The future regime should treat mitigation, adaptation, technology and financing in a more balanced manner. Further, it was recommended that the implications of the various regime proposals and targets (e.g. 50% global GHG reduction by 2050) on future prospects for development of Asian countries should be examined thoroughly.

Stakeholders recognised the need to differentiate developing countries in the future climate regime based on national circumstances, responsibility, capacity, mitigation potential, and adaptation needs. One anomaly noted is that some non-Annex I countries have higher GNP and per capita GHG emissions than a few Annex I countries. Commitments by developing countries could be different from those of industrialised countries, and might include policy-based or sectoral approaches. A forum specifically focusing on developing countries in Asia may help reach a consensus on such commitments. Strengthening the negotiating capacity of Asian developing countries, especially LDCs and SIDS, was considered crucial to increase their involvement in discussions on the future climate regime.

(ii) Energy security and development

Policymakers stressed that the future regime should enable economic development to proceed in a sustainable manner in developing Asia. Discussions on the future regime would benefit greatly from identifying linkages between the regime and processes that can help

countries achieve the MDGs. Since non-climate policies offer significant potential to reduce GHG emissions and enhance adaptive capacity, post-2012 regime discussions should focus on building synergies between climate initiatives and efforts in other sectors, including national development planning. Mechanisms to reward such efforts should also be created.

An analysis of 20 proposals for the post-2012 regime revealed that the efforts to reflect Asian concerns on development in climate negotiations have been limited. Top-down approaches, which were intended to achieve long-term stabilization of global GHG emissions, had a single criterion (e.g. emissions per capita) and very few indicators of direct relevance to Asia (energy security and development). In view of the lack of attention to sustainable development, it is recommended that the future climate regime identifies and facilitates the most pragmatic measures to mainstream climate concerns in energy and development planning, and supports the implementation of integrated development and climate strategies at various levels.

Some participants argued that international commitments based on energy intensity may not serve the interests of developing countries in Asia due to difficulties in predicting the future growth rates of different sectors and their shares of GDP, and due to close links between energy intensities and natural resource endowments in specific economies. However, the need for increasing EE levels by following approaches such as “top runner standards” in all countries was stressed.

Improving energy security and access through maintaining affordable energy supplies is crucial to achieving economic development and realizing climate benefits in Asia. Strategic international cooperation through effective investments, as well as policies and measures to improve EE and promote RE will play an integral role in achieving lower GHG emissions in the region and reducing vulnerability to regional and global energy insecurity. Since energy security is an issue on which both developing and developed countries share common interests, the future climate regime should facilitate further development of climate-friendly energy policies. This can be accomplished, for instance, by sharing good practices, setting standards and guidelines, building adequate human and institutional capacities, and initiating new partnerships for regional collaboration.

The future climate regime will not be effective unless it is sensitive to the diversity in developmental needs and aspirations of developing countries in Asia. Unsustainable development in the region will certainly lead to high GHG emissions that will exacerbate climate change. Future regime discussions should focus more on social and economic co-benefits from mitigation policies, thus helping LDCs achieve the MDGs and providing assistance to efficiency concerns in newly industrialised countries. Operational support from the climate framework, for example, by maintaining a registry of sustainable development policies and measures (SD-PAM) with synergies between sustainable development benefits and GHG mitigation, is critical to mainstreaming climate risks in the development agenda.

To further strengthen the recognition and rewarding of co-benefits in the future regime, it was suggested that (i) researchers should standardise rapid analytical methods to evaluate the developmental contribution of pledged policies (to be verified by an international body with more rigorous analytical tools); (ii) policymakers should conduct an assessment on integrated policies that stand to benefit the most from regime-related financial and technical support; and (iii) climate negotiators should gradually scale up these institutional reforms in multiple stages, beginning with voluntary pledges, piloting standardised tools and rewarding integrated policies.

(iii) Market mechanisms

Stakeholders noted that market mechanisms, such as CDM, are beginning to have a positive impact on developing countries in Asia. Options for employing "baseline and credit" or "cap and trade" mechanisms should be explored in all Asian countries. Further strengthening of CDM through simplified methodologies and the inclusion of additional sectors was considered crucial to improve geographic equity and enhance sustainable development benefits. The scope of CDM beyond 2012 may be broadened to include sectoral and policy-based approaches, while aligning with development policies in industrial and land use sectors. Sectoral approaches may be more successful if applied first in sectors that cater principally to domestic markets. In sectors that serve international markets, trans-national targets set by multinational corporations (MNC) and industrial associations may succeed. In developing Asia, coal-fired electricity generation, iron and steel, cement, and forest conservation appear to be good candidates for sectoral approaches, although specific challenges remain to be overcome in each sector.

Effective integration of sectoral approaches in a post-2012 climate regime requires considerable progress on at least three fronts: (i) step-wise institutionalization at national and international levels; (ii) preferential support and reliable incentives; and (iii) sector-specific initiatives by MNCs (in sectors such as iron and steel, cement, and aluminium). Collecting valid data from the energy emissions and technology standpoints to develop sector-specific benchmarks and performance indicators, building synergies between the UNFCCC and other initiatives, and accumulating useful lessons from programmatic CDM are crucial. Sectoral approaches, however, can only be a part of the solution, complementing but not replacing Kyoto-style economy-wide reductions.

(iv) Funding mechanisms

Participants noted that CDM can only be a supplemental source for financing clean energy in the region and that the mobilization of resources outside the UNFCCC is crucial. The post-2012 regime should promote synergies with new initiatives from multilateral financial institutions. The World Bank's "Investment Framework for Clean Energy and Development", "Carbon Market Continuity Fund" for purchasing post-2012 credits and "Carbon Facility for Low Carbon Growth" for GHG reduction through long-term investment and technology expansion are all important for moving Asia to a low carbon economy. Likewise, the ADB is developing a carbon market initiative to boost the alternative clean energy projects in developing countries, and will allocate \$1 billion of annual lending for EE through a proposed Asia Pacific Fund for Energy Efficiency (ADB 2006). In May 2008, ADB launched a new Climate Change Fund with an initial allocation of \$40 million to facilitate greater investments in developing countries in Asia and the Pacific to address the causes and impacts of climate change. Some participants suggested creating a major regional RE programme based on Asia's natural resource endowments by establishing, for example, a specialised regional bank for RE. Such a bank could fund necessary R&D on RE and provide seed funding for renewable energy service corporations (RESCO) and matching funds for national subsidy programmes. To enhance investments and financial flows in the development and deployment of low-carbon technologies, creating a global R&D fund and linking financial contributions with emissions reduction commitments might be useful. The need for broadening the funding base for adaptation and creating new mechanisms to involve the private sector in adaptation was also highlighted (see section 4.2.4).

(v) Access to low-carbon technologies

Asian stakeholders expressed serious concerns about the ability of the current climate regime to facilitate the deployment of clean technologies in developing countries, as progress remains far below the levels required to change the GHG emissions growth trajectory in the region. Participants noted that further progress would be feasible if discussions on the future regime can lead to (i) improving finance to accelerate technological R&D cooperation; (ii) building synergies between technology initiatives within and outside the climate regime; and (iii) enhancing the flexibility of the IPR regime for low carbon technologies. It was stressed that the post-2012 regime should consider political feasibility (in terms of self-enforceability, provision of side-payments, and the fit with domestic interests and institutional arrangements) of technology-oriented proposals, while paying particular attention to the interests and capacity of provincial and local governments.

The post-2012 regime should proactively facilitate synergies with non-UNFCCC initiatives. For example, the climate regime can provide CDM opportunities in methane recovery and additional income for project developers, while the methane to markets (M2M) initiative and/or the Asia-Pacific Partnership (APP) can provide access to necessary technologies. Likewise, technologies for carbon capture and storage (CCS) may be transferred through the APP, if the future climate regime makes CCS projects eligible for CDM.

The future climate regime should create additional incentives for countries willing to move towards low-carbon technology pathways and adopt international technology standards. Some options to enhance the flexibility of IPRs for low-carbon technologies include (i) research collaboration with developed countries in the early stages of technology development leading to joint ownership of IPRs, and (ii) the creation of a multilateral technology acquisition fund, which could be structured to buy-out IPRs and make privately owned, climate-friendly technologies available for deployment. Compulsory licensing of high priority technologies may be considered along the lines of initiatives such as the US Clean Air Act. However, it is critically important to assess whether and to what extent IPRs are actual barriers to technology transfer. A domestic policy push, including the specification of contemplated climate actions by public authorities to the private sector, a flexible IPR regime, administrative coherence within developing countries and incentives from developed countries are all crucial to making vertical and horizontal technology deployments economically and politically feasible.

Ensuring additional finance through innovative public and private support mechanisms, including the creation of venture capital funds, is also critical to make the currently available technologies commercially competitive. The future climate regime should play a facilitative role in (i) determining the incremental costs associated with the acquisition of clean technologies that are relevant to Asia, and (ii) documenting the success stories of various policy instruments that can offset the higher costs of emerging technologies.

(vi) Adaptation

IGES consultations stressed that the future climate regime should pay as much attention to adaptation as it does to mitigation. Designing a separate protocol on adaptation may enhance its profile, but the process may require considerable resources and time in terms of negotiation. Participants stressed that the future regime should pay particular attention to (i) fair burden sharing mechanisms based on the “emitters pay,” “ability to pay” and “climate change winners pay” principles; (ii) adequate

and predictable levels of funding; (iii) innovative risk transfer mechanisms such as insurance; and (iv) mainstreaming adaptation into the sustainable development agenda. It was recommended that a combination of both “top-down” support and “bottom-up” engagement is crucial to advance the adaptation agenda. The future climate regime should facilitate mainstreaming by providing practical examples, improving capacities and requiring that all development policies undergo an “adaptation check.” Creating effective incentive schemes at the local, national and international levels was considered crucial for mainstreaming adaptation.

Since the demand for adaptation funds will increase in the future as climate change proceeds in the region, there is a need for (i) enlarging the funding base and developing flexible but clear guidelines to access adaptation funds; (ii) differentiating between actions that can be funded inside and outside the climate regime; and (iii) creating market mechanisms and incentives for the private sector to involve them in adaptation efforts. Options for establishing a mandatory global funding scheme, which is tied to both past and current GHG emissions by various countries, should become a greater priority. In addition, prospects for creating a regional adaptation fund based on a levy on foreign direct investment (FDI) in the region should be explored.

4.1.2. Assessment of post-2012 regime proposals

There is no shortage of proposals or alternative policy frameworks for the post-2012 climate regime. A recent count suggests that there are more than 120 proposals based on one or more elements of the future climate regime, namely: (i) goals (targets and timetables); (ii) participation (nature and type); (iii) actions (standards for certain sectors of the economy, financial payments and transfers, market-based mechanisms, technology development and transfer, and adaptation); (iv) institutions; and (v) compliance provisions. However, it is troubling that very few proposals have been made by negotiators and researchers from developing countries in Asia. In a few proposals, some involvement of researchers from developing Asia was noted but there was little evidence that they took the lead. Several proposals failed to reflect Asian needs, concerns, and aspirations mentioned earlier and none examined implications for the future development of Asian countries.

An attempt was made to assess strengths and weaknesses of various proposals in which involvement of Asian researchers and policymakers was evident (table 2.9). Some proposals (e.g. Kim and Baumert 2002, Kameyama 2003) support the continued use of targets and timetables, while others seek to promote greater integration between climate and development objectives (e.g. Heller and Shukla 2003). A few proposals focus on multi-stage approaches (Ott et al. 2004; Parikh 2007), while others take a more fragmented approach by focusing on single issues such as sectoral approaches or technology transfer or financial mechanisms (e.g. Dasgupta and Kelkar 2003; Chung 2006; Halsnæs and Shukla 2008). The proposals were then assessed on the basis of criteria such as distributional equity, cost-effectiveness, environmental outcome, and flexibility. Unfortunately, none of the reviewed proposals met all criteria, thereby demonstrating the complexity of developing a comprehensive, equitable and effective framework. A similar conclusion was reported by den Elzen (2002) and Bodansky et al. (2004) based on an analysis of more than 40 proposals. Since interests of various groups among developing countries (Alliance of Small Island States (AOSIS), Organisation of the Petroleum Exporting Countries (OPEC), Organisation for Economic Cooperation and Development (OECD), LDCs) vary widely with respect to the future

climate regime, future negotiations should focus on the use of various complementary policy tools that align with national developmental priorities and circumstances (such as technological cooperation, climate related trade rules, carbon taxation, carbon sinks, a global adaptation fund, forest preservation, biofuels, and energy infrastructure). This will enable more effective participation of developing countries in the future climate regime.

4.1.3. Suggestions for a possible new framework

Climate negotiators now face several dilemmas, such as (i) mitigation policies versus adaptation policies; (ii) mitigation targets versus financing, technology and adaptation targets; (iii) Kyoto-style market mechanisms versus domestic regulatory instruments; (iv) policy incentives versus restrictions and penalties; (v) climate-focused policies versus non-climate policies with climate benefits; (vi) multilateral actions under the UNFCCC and the Kyoto Protocol versus unilateral or bilateral initiatives by a few parties outside the UNFCCC.

Because achieving consensus among all of the UNFCCC parties on an equitable and effective multilateral framework has been difficult, several schemes involving only a few countries have emerged in recent years (G8, Gleneagles [G8+5], G20, APP, APEC, International Carbon Action Partnership [ICAP], and others). Indeed, some researchers now believe that the adoption of a bottom-up, country-driven approach to national mitigation commitments by like-minded countries may be more effective than a top-down global approach and that regional or issue-specific climate blocks might form in the future as has happened in trade negotiations (Sugiyama and Sinton 2005; Carraro 2006). However, as most countries in Asia favour an inclusive multilateral framework instead of a fragmented regime, strenuous efforts to ensure global participation are needed. Furthermore, bottom-up approaches have been incapable of demonstrating how significant emission reductions could be achieved to stabilise GHG concentrations. An inclusive framework may also avoid the possibility of a steep increase in GHG emissions by non-participating countries due to migration of emission-intensive industries from participating countries. Finally, an inclusive framework may allay concerns that a few countries would focus on mitigation and will divert attention from adaptation, technology and finance --- issues that are of equal or greater importance to developing countries in Asia.

Our preference, therefore, is for a multi-stage, multi-track, all-inclusive framework (fig. 2.2). The framework would be characterised by (i) progressively increasing emission reduction and adaptation commitments or actions; (ii) differentiated financial and technological incentives and compliance provisions; and (iii) a new grouping of countries based on responsibility, capability, mitigation potential and vulnerability. In this new grouping, the mean annual anthropogenic per capita emissions since the adoption of the UNFCCC in 1992 would serve as a proxy indicator for "responsibility," while the United Nations Development Programme (UNDP) human development index (HDI) would indicate "capacity." In addition, developing nations that contribute more than 1% of global GHG emissions would have more responsibility and potential for mitigation than others. The climate vulnerability index developed by the Oxford Centre for Water Research would act as a proxy indicator for "vulnerability."¹⁶ In this framework, the grouping of countries would be adjusted at the beginning of each commitment period; thus countries would graduate from one grouping to another over time, depending on changes in GHG emissions, HDI, etc. The grouping of developed and developing countries, largely reflects the current classification of Annex I and non-Annex I countries of the UNFCCC. This is mainly done to avoid renegotiation of the fundamental basis of the current climate regime.

Table 2.9. Preliminary assessment of selected proposals to which Asian researchers and stakeholders contributed

Proposal	Main features	Strengths	Weaknesses	Distributional equity	Cost-effectiveness	Environmental outcome	Flexibility
Basic needs or survival emissions or Human Development Goals with Low Emissions (Aslam 2002; Pan 2003; Pan 2005)	-Encourages developing country commitments through a bottom-up, country-driven process that is linked to human development goals. -Targets allow emissions to satisfy basic human needs, but limits emissions linked to luxury goods and services. Key elements include: Identification of development goals/basic human needs; voluntary commitments to low carbon paths via no-regret emission reductions in developing countries conditional on financing and obligatory discouragement of luxurious emissions; reviews of goals and commitments; an international tax on carbon.	-Focus on human development goals.	-Difficult to attract developed countries.	✓	-	-	-
Bottom-up or multi-facet approach, pledge and review (Yamaguchi and Sekine 2006)	-Each country creates its own initial proposal relating to what it might be able to commit to. Individual actions accumulate one by one. The collective effect of proposals is periodically reviewed for adequacy and – if necessary – additional rounds of proposals are undertaken.	-Global participation is feasible.	-	-	-	✓	✓
Development and climate (Heller and Shukla 2003)	-A multifaceted approach seeking to accelerate climate-favouring energy and transport systems by linking climate-specific national and international efforts with non-climate programmes supporting development paths with less climate impact. -Suggests (a) flexible input-based programmes, sectoral or indexed goals, or commitments for developing countries, (b) programmatic climate cooperation, (c) regional cooperation, and (d) targeted use of ODA.	-Focuses on integrating development and climate objectives.	-Does not discuss incentives for developed countries or ways to reduce emissions in developed countries.	-	-	-	✓
Dual Intensity Targets (Baumert et al. 1999; Kim and Baumert 2002)	-Developing countries have two types of targets, a relatively stringent but non-legally binding target, and a relatively weak, legally binding target.	-Encourages developing country participation.	-Implementation challenge for emission trading.	✓	-	-	✓

Dual Track (Kameyama 2003)	-Incentives for participation of developing countries. -A country has a choice between two tracks, a pledge of domestic policies and measures, or a binding emissions target.	-National circumstances are considered.	-Does not consider historical responsibility for emissions.	✓	-	-	✓
Expanded "Common but Differentiated" (Gupta and Bhandari 1999)	-Allocation of national emission targets on a per capita basis. -A transitional regime for Annex I countries until 2025.	-Equity issues addressed.	-Difficult to get developed countries involved.	✓	-	✓	-
International Agreements on Energy Efficiency (Ninomiyama 2003)	-Negotiation of an international agreement on EE. -Develop international standards for appliance efficiency.	-Participation by the United States and major developing countries is expected.	-No compliance measures.	-	-	-	✓
Keep It Simple, Stupid (KISS) (Gupta 2003)	-Methodology for differential commitments to get developing countries involved in a future climate regime. -Twelve categories of countries, each with a different package of commitments.	-Equity and development issues addressed. -Technology transfer is mandated.	-Difficult to get developed countries involved.	✓	-	✓	-
Multi-Dimension Structure (METI 2004)	-Need for a multi-faceted approach by governments, industries, NGOs, and individuals.	-Participation of all stakeholders.	-Limited attention to cost or environmental outcome.	-	-	-	✓
Multi-stage proposal (Parikh 2007)	-Groups countries into three categories: Annex 1; Non-Annex 1 with per capita emissions above global average; Non-Annex 1 with per capita emissions below global average.	-Fair.	-May exclude major developing countries with high mitigation potential.	✓	-	-	✓
Orchestra of Treaties (Sugiyama et al. 2003)	-A system of separate treaties among like-minded countries or a decentralised approach, involving four building blocks, "a group of emissions markets (GEM)", "a zero emissions technology treaty (ZETT)", "a climate-wise development treaty (CDT)", and the UNFCCC (monitoring, information, funding).	-CDT addresses adaptation and technology transfer.	-Compliance is not addressed.	✓	-	-	✓
Per Capita Allocation (Agarwal et al. 1999)	-Several burden-sharing approaches based on equal per capita emissions entitlements.	-Equity issues addressed.	-Per capita basis indicators may exclude major emitters.	✓	-	✓	✓
Quantitative finance commitments (Dasgupta and Kelkar 2003)	-Annex I countries take on quantitative financial commitments – e.g. expressed as a percentage of GDP – in addition to emission reduction targets.	-Reduce uncertainty regarding cost.	-Incentives for developed countries to accept commitments are lacking.	✓	✓	-	-

<p>Sao Paulo BASIC Proposal (BASIC 2006)</p>	<p>-Comprehensive proposal for a stable, long-term universal regime based on principles of equity, common but differentiated responsibilities and respective capabilities.</p>	<p>-Emphasis on equity -Adaptation, technology transfer and sustainable development are included.</p>	<p>-Modalities for implementation are vague.</p>	<p>✓</p>	<p>✓</p>
<p>South-North Dialogue (Ott et al. 2004)</p>	<p>-Proposal made by 14 researchers from all regions of the world including Asia, and defines six groups of countries that should take differentiated types of mitigation commitments. Developed countries are divided into two groups (Annex 1 and Annex II) and developing countries are grouped into four types based on responsibility, capacity and mitigation potential. Developed countries have quantitative mitigation commitments based on Kyoto-style targets. Among developing countries, newly industrialised countries (NICs) and rapidly industrializing developing countries (RIDCs) will have quantitative commitments while other developing countries and LDCs will have qualitative mitigation commitments focusing on policies and measures.</p>	<p>-Gradual involvement of all countries. -Enhanced focus on adaptation. -Recommends overcoming "block mentality".</p>	<p>-Criteria for differentiation are vague and may become controversial during negotiations (e.g., per capita basis indicators could exclude major emitters) -Quantitative absolute commitments for NICs and RIDCs may be difficult to negotiate given uncertainties in future economic growth, and the need for providing energy access in many countries.</p>	<p>✓</p>	<p>✓</p>
<p>Sustainable Development and Climate Finance Mechanism (SDCFM) (Halsnæs and Shukla 2008)</p>	<p>-Outlines an institutional mechanism to bring finance from an expanded carbon market to fund integrated policies (policies with climate and development benefits). -The mechanism (a) helps sellers and buyers agree upon standards for reporting and assessing GHG reductions and development benefits of integrated policies and (b) acts as a bridge between the voluntary and formal carbon markets.</p>	<p>-Expanded carbon market would compensate for many of the shortcomings of the CDM (e.g. overly stringent additionality rules).</p>	<p>-Decentralised monitoring might weaken the environmental integrity of the mechanism.</p>	<p>✓</p>	<p>-</p>

Three-track approach (CAN 2006)	-Comprehensive institutional architecture with three parallel tracks: 1. Kyoto track with legally-binding targets, 2. Greening (decarbonisation) track – introduce clean technology from developed to developing country, and 3. Adaptation track – provide resources to the most vulnerable regions. -Provides an incentive for Non-Annex I countries for CDM. -Only a certain portion of CER is allowed to be sold to the entities of Annex I.	-Encourages involvement of all countries. -Adaptation track designed to help vulnerable countries. -Encourages participation of developing countries. -Deeper reduction of CO ₂ emissions.	-Criteria for graduation may be contentious.	✓	-	-	✓
Unilateral CDM with certified emissions reduction (CER) discounting (Chung 2006)	-Provides an incentive for Non-Annex I countries for CDM. -Only a certain portion of CER is allowed to be sold to the entities of Annex I.	-Encourages participation of developing countries. -Deeper reduction of CO ₂ emissions.	-Achieving consensus on discounting rates is difficult.	-	✓	-	-
United Nations Emissions Trading Scheme (Saijo 2006)	-Each country purchases emissions credits from the UN by auctioning. -Developing countries receive more revenue from selling emission credits than developed countries.	-Scheme can be adjusted depending on national circumstances and developmental priorities.	-Modalities of implementation are vague.	✓	-	-	✓

Sources: IPCC (2007), Bodansky et al. (2004).
 Note: Tick marks represent stronger points of the proposals.

Figure 2.2. A diagram showing differentiated commitments and incentives in a future climate regime

Criterion	Proxy Indicator	Developed countries (Current Annex I Parties)				Developing countries (Current non-Annex I Parties)				
		Group A >4 tCO ₂ e >0.90 ----- -----	Group B >4 tCO ₂ e 0.75-0.90 ----- -----	Group 1 >4 tCO ₂ e >0.90 ----- -----	Group 2 >2 tCO ₂ e 0.75-0.90 >1% Medium High	Group 3 <2 tCO ₂ e <0.75 >1% Medium High	Group 4 >2 tCO ₂ e >0.75 <1% High	Group 5 <2 tCO ₂ e <0.75 <1% High		
Responsibility	Per capita emissions	Japan	Russia	Rep. of Korea	China	India	Fiji	Bangladesh		
Capacity	Human development index	2018-2020 2021-2030								
Potential for Mitigation	Gross national emissions as % of global emissions									
Vulnerability	Climate vulnerability indicator (Oxford)									
Typical country fitting the criteria		Japan	Russia	Rep. of Korea	China	India	Fiji	Bangladesh		
International Commitments	Mitigation									
	Adaptation									
National Commitments	Mitigation									
	Adaptation									
Incentives for Mitigation	Participation in market mechanisms	All types	All types	All types	CDM-type mechanisms only	CDM-type mechanisms only				
	Finance									
	Technology									
Incentives for Adaptation	Capacity building									
	Finance									
	Technology									
	Capacity building									

Notes: 1. This diagram provides only an approximate, not a precise, illustration of the varying commitments and incentives for different sets of countries.
 2. The lengths of the bars illustrate how commitments and incentives compare across countries; they are only indicative and are not based on numerical data.
 3. Areas shaded in black correspond with the period 2013-2020. Areas shaded in grey correspond with the period 2021-2030.

The framework has four distinguishing features. First, it divides developed and developing countries into sub-groups consistent with their national circumstances, responsibilities and capacities. Reaching consensus on such classification at the beginning of each commitment period may be complex and politically difficult but the proposal with its incentive and compliance provisions would achieve global participation and meet four important criteria—distributional equity, cost-effectiveness, environmental outcome and flexibility. Second, a longer commitment period of eight or ten years instead of five years would provide a more credible signal to the private sector. Third, the adoption of multi-track approaches and new types of commitments would enhance flexibility, thereby giving countries the freedom to achieve their goals in whichever ways suit them best. Fourth, the framework also makes adaptation commitments or actions mandatory for certain groups of countries through adequate recognition of the most vulnerable countries' needs.

The above framework is designed to promote convergence of per capita emissions over time and with a long-term vision of achieving per capita emissions around 1 tCO₂e and enhanced climate-resilience in all countries by around 2100. The idea that national emission entitlements should gradually converge towards equal per capita levels is again gaining attention after it has been recently outlined by the German Chancellor Angela Merkel (Evans 2007). However, it is also recognised that GHG emissions in some developing countries with low to medium levels of HDI would continue to grow in the medium term (e.g. up to 2030) to meet their social and development needs. The first and second periods of commitment for the above framework would correspond to 2013-2020 (in black on fig. 2.2) and 2021-2030 (in grey on fig. 2.2) respectively.

It must be noted that the threshold values suggested here are only *indicative*. In order to fully stabilise GHG concentrations near or below the critical 500 ppm threshold, the global average per capita GHG emissions will need to be around 2 tCO₂e by 2050 (Stern 2008). This is based on the logic that total anthropogenic GHG emissions will need to decline to less than 20 GtCO₂e per annum by 2050 (population around 9 billion) from about 45 GtCO₂e in 2005. In the framework proposed here, we used a two-stage approach for grouping of countries.

In the first stage, countries with per capita emissions greater than 4 tCO₂e (twice the targeted value of 2 tCO₂e for 2050) are identified. All the current Annex I Parties and several developing countries are above the 4 tCO₂e threshold. Those countries are then classified into three groups based on their HDI value (i.e., developed countries with HDI above 0.9, developed countries with HDI between 0.75 and 0.90, and developing countries with HDI above 0.9).

In the second stage, the remaining developing countries with HDI levels below 0.9 are classified into four groups based upon (a) the targeted value of 2 tCO₂e as a threshold, (b) their contribution to global emissions, and (c) the climate vulnerability indicator. As mentioned earlier, those countries that account for more than 1% of global emissions are considered to have a greater responsibility to contribute to the success of the future climate regime. It is also considered that those countries have greater mitigation potential than others. This is because some of those nations have large geographical areas and offer more cost-effective mitigation opportunities (including carbon sequestration). Further, some of those nations have access to technologies that can lower GHG emissions substantially. However, due consideration is given to provide additional incentives to those countries with lower HDI values and higher vulnerability indicators.

(i) Developed countries

In the above framework, GHG emission reduction commitments for developed countries (with per capita emissions of more than 4 tCO₂e and HDI above 0.75) would be deep and legally binding with strong compliance requirements. The targets would be based on sound science and reflect the latest IPCC guidance (e.g. 25-40% reduction by 2020 and 60-80% by 2050). To achieve these targets, the regime would include both national and international commitments for mitigation and adaptation (see fig. 2.2). “National commitments” would be agreed upon internationally but would be achieved chiefly within the host country (with some possibilities for using market mechanisms for mitigation). “International commitments” would be agreed upon internationally and then be implemented in the form of reportable, measurable and verifiable measures for technological, financial and capacity building support for mitigation and adaptation from developed to developing countries. The nature and magnitude of national and international commitments may vary with differences in levels of development. For example, developed countries with an HDI above 0.9 (Group A) would have *strong national* mitigation commitments and *strong international* mitigation commitments, as well as *strong international* adaptation (assistance) commitments. On the other hand, developed countries with an HDI between 0.9 and 0.75 (Group B) would have *substantial national* and only *limited international* mitigation commitments. Thus, Group A countries correspond to the current Annex II countries of the Kyoto Protocol while Group B countries are mainly the economies in transition (EIT). However, the nature and magnitude of commitments of both groups are different from those in the first commitment period of the Kyoto Protocol.

For Group A countries, threshold values for national and international commitments would be negotiated and adopted prior to the start of each commitment period. For example, at least 75% of the national commitment would be met through domestic actions, 15% through the use of flexibility mechanisms and 10% through efforts to promote technologies, enhance financial flows and strengthen capacity in EIT and developing countries. The average price per tonne of carbon emissions traded internationally over the preceding commitment period (initially 2008-2012) would form the basis for determining thresholds in the subsequent commitment period. For Group B countries, no such threshold values would be applicable, although they would be encouraged to promote the transfer of appropriate technologies to developing countries. Compliance requirements for Group A countries would be more stringent than those for Group B countries.

(ii) Developing countries

In the above framework, the nature and form of participation of developing countries would vary significantly from the current regime’s emphasis on “targets and timetables.” Five groups of countries are envisioned with varying levels of *national* commitments and associated incentives. All groups would have domestic commitments for mitigation and/or adaptation but the nature and extent of the commitment would vary. The nature and magnitude of incentives would also vary. The framework assumes that most developing countries will graduate from one group to another over time, which in turn involves differentiated commitments and incentives.

- Group 1 includes industrialised developing countries with high per capita emissions (e.g. above 4 tCO₂e) and high HDI levels (e.g. above 0.90). Typically, the group may include OECD non-Annex 1 countries (e.g. the Republic of Korea, Mexico),

and countries with levels of economic development similar to those of OECD countries (e.g. Singapore). For this group, the *national* commitments for the first commitment period (2013-2020) and subsequent commitment period (2021-2030) would be similar to those for Group B developed countries, with additional flexibility on compliance requirements, perhaps through borrowing arrangements. As an incentive, countries in this group would be allowed to participate in all types of international emissions trading, and would be eligible for technological and financial flows and support to enhance institutional and human capacities, mainly for GHG mitigation. Group 1 countries will receive only very limited incentives for adaptation from the international regime.

- Group 2 includes countries with large gross national emissions (>1% of global emissions), per capita emissions above 2 tCO₂e, HDI above 0.75, and a medium high level of vulnerability. Typically, a country like China would fit this description in Asia. In the proposed framework, countries in Group 2 have important obligations for global climate stabilization not only because of their high national contributions to global emissions but also due to rapid growth in their per capita emissions and HDI recently. Many studies confirmed that attaining GHG stabilization targets (e.g. 500 ppm) to avoid dangerous levels of climate change would be impossible without effective mitigation strategies by this group. As a start, therefore, this group would commit to nationally appropriate sectoral EE targets by 2020 supported by technological and financial flows from international financial institutions and Group A countries. Also further actions such as (i) setting economy-wide goals with full consideration of various sub-national circumstances and factors such as “embedded emissions”; (ii) fuel economy standards for automobiles and enhanced efficiency standards for buildings and other infrastructure; (iii) RE targets; and (iv) measures to improve carbon sequestration would be necessary. In this context, it is heartening to note that considerable progress is already evident in countries like China, where fuel efficiency standards are much higher than in the US (UNDP 2007).

During the first phase of commitment (2013-2020), sectoral targets for Group 2 would be subject to the same compliance provisions applied to Group 1 countries. The actions in other areas, however, would be “no lose” targets on a “pledge and review” basis and no penalties would be applied for the lack of compliance. From the year 2021 onwards, however, the same compliance provisions applied to Group 1 countries would apply to Group 2 countries in all types of commitments and actions, except for those related to carbon sequestration. The countries would be eligible to sell emission reduction credits not only through those achieved from sectoral EE target realisation plans, but also project-specific emission reductions in sectors without targets. Group 2 countries would receive, in general, more incentives than Group 1, especially for GHG mitigation in the form of participation in CDM-type mechanisms and additional financial and technological flows from developed countries. To realise sector-wide EE targets and achieve the most cost-effective emission reductions worldwide, developed countries would provide technological assistance to priority sectors in Group 2 countries commensurate with the targets set for 2020. Support from international financial institutions, carbon markets and non-UNFCCC initiatives such as APP would be crucial in this regard. Through effective involvement in market mechanisms, countries in this group would be expected to bear most of their own adaptation costs. However, some form of support in adaptation technologies and capacity strengthening would be provided, especially during 2013-2020.

- Group 3 includes countries with large gross national emissions (>1% of global emissions), low per capita emissions (e.g. below 2 tCO₂e) and lower HDI levels (e.g. below 0.75). Typically, a country like India would fit this description in Asia. This group would strengthen EE and RE goals, fuel economy standards for automobiles, efficiency standards for buildings and other infrastructure, and actions designed to conserve forests during the first period of 2013-2020. In addition, nationally appropriate targets in one or two sectors would be taken up with support from the international regime. Provided that HDI levels reach satisfactory levels, this group of countries is expected to take on a similar role as that of Group 2 during the period of 2021-2030. Group 3 countries would be eligible to sell project-specific emission reductions in all sectors. All types of incentives—finance, technology and capacity strengthening—would be provided largely for GHG mitigation and partly for adaptation. In general, the extent of support would be more than that in Group 2 but it would decrease in the period 2021-2030.
- Group 4 countries are characterised by limited gross national emissions (<1% of global emissions), per capita emissions above 2 tCO₂e, HDI above 0.75, and high climate vulnerability. Typically, a country like Fiji would fit this description in the Asia-Pacific region. This group would not be required to take up mitigation commitments but should commit to adaptation actions and their integration into national development plans. Internationally, they are expected to support adaptation efforts in other developing countries with lower HDI, and share information on good practices. They would receive limited incentives in the form of technology and capacity strengthening for mitigation, and all forms of incentives for adaptation.
- Group 5 includes countries with low gross national emissions, low per capita emissions and low HDI levels (mostly LDCs) and high vulnerability indicators. Typically, a country like Bangladesh would fit this description in Asia. They would be required to internationally pledge adaptation actions such as integration of adaptation concerns into their national development plans, and show progress in adaptation actions through an international review mechanism. They would be eligible for all types of incentives primarily for adaptation.

Whatever the precise form may be, all actions will need to be realistic and supported by commitments, with mechanisms to ensure measurable, reportable and verifiable progress. Insofar as GHG mitigation is concerned, the outcome of optimal or cost-effective “national” climate actions in various countries in Asia could be more than the outcome of “international” commitments made by these countries. As the above framework relies on a differentiated and wide-range of incentives, further work on innovative options to enable financial and technological flows for mitigation and adaptation in developing Asia is necessary. For this to happen, more effective involvement of the private sector, especially those segments of industry that are increasingly contributing to the growth in emissions such as aviation, must be considered. An aviation levy, a global carbon tax on traded commodities and a levy on FDI are likely to raise adequate amounts of funds to be used as incentives in the above framework. In addition, efforts to reduce inter- and intra-regional, high- and low-income group disparities in GHG emissions should be promoted, recognised and rewarded in all countries. Such proactive and effective participation of various countries in the future climate regime may ultimately lead to achieving a low-carbon climate-resilient society in Asia.

4.2. Enhancing adaptive capacity of Asian populations and ecosystems

As noted in section 3, adaptation has received only limited attention both at the international level and at the national level in Asian countries, even though projected climate hazards in Asia are severe, and the region has many vulnerable populations and ecosystems. Even if GHG emissions were stabilised now, climate change impacts are going to be felt in Asia for a long time. Enhancing the adaptive capacity of Asian populations and ecosystems, therefore, is a crucial step for achieving sustainable development in the region and will require multiple efforts at temporal (short, medium and long term) and spatial (international, regional, national and local) levels (table 2.10).

In the short term, Asian countries should focus on measures such as flexible farming systems, traditional weather-resistant farming practices, improved disaster preparedness and public awareness. In the medium to long term, early warning and monitoring systems and hazard mapping, and measures such as reforestation (with both mitigation and adaptation benefits), engineering of structures in coastal areas, and land use planning will be crucial, but can be initiated now.

Table 2.10. Steps to enhance adaptation at different levels

Level	Examples
Local	<ul style="list-style-type: none"> ➤ Identification of strategies for facilitating proactive micro-adaptation with the participation of local communities and local governments ➤ Exchange of best practice guidelines and lessons learned at the local level
National	<ul style="list-style-type: none"> ➤ Mainstreaming climate change in national and sector development planning, through changes in policies and institutions, including technology deployment ➤ Strengthening the capacity of national institutions to seek complementarities among the environment and development frameworks by linking NCs and NAPAs with poverty reduction strategies and MDGs ➤ Prioritising short, medium, and long-term adaptation actions which have a direct bearing on the livelihoods of vulnerable communities ➤ Involving the private sector in adaptation activities by providing necessary incentives such as tax exemptions ➤ Integrating alternative livelihood strategies for extreme climatic events through national disaster management plans, including the dissemination of seasonal climate forecasts
International	<ul style="list-style-type: none"> ➤ Developing an international consensus on the scope of adaptation and means to enhance the availability and access to adaptation funds ➤ Identifying and building on inter-linkages between various forms of communication (scientific, implementation and reporting linkages) ➤ Supporting the Clearing House mechanisms for the UNFCCC and the Kyoto Protocol at the regional and international levels ➤ Building synergies among subsidiary bodies of CBD, UNCCD and UNFCCC ➤ Awareness raising, education and public participation

Source: Srinivasan (2006b)

No country in the region has an overall national policy framework in place on climate change adaptation. The development of such a policy framework, however, requires a system of legal frameworks that stipulates rights and responsibilities, institutions at various levels and clearly defined roles for various players. The recent initiative by China's Ministry of Science and Technology to develop a national adaptation policy framework, which sets out roles and responsibilities for different levels of governments

as well as the private sector to streamline responsibilities among different institutions, can be a good model for other countries to emulate.

4.2.1. Regional cooperation on adaptation

To strengthen national capacity to address adaptation, opportunities for regional cooperation must be addressed soon. As most countries in Asia experience similar climatic hazards, regional strategies are likely to be more cost-effective than multiple national and sub-national actions. Cooperation is especially relevant in developing regional climate scenarios and models to monitor and evaluate climate change impacts and methods to quantify the costs and benefits of adaptation.

Regional cooperation on adaptation can ensure proper coordination, optimization, cost-effectiveness and efficiency of transboundary sectoral adaptation policies and measures such as integrated river basin management, forest fire management and early warning systems. It would also help Asian countries to minimise reactive, costly and un-planned adaptations or mal-adaptations in response to climate disasters. Regional cooperation will further enhance capacity in “climate proofing” current and future investments, and in ensuring that MDGs in any country are not at risk. Finally, institutional capacity in the region for generating high quality climate information with improved regional predictions, and for providing uniform and comparable adaptation assessment data for all countries can be enhanced. Regional cooperation can be most effective if there is policy convergence, institutional transparency, effective stakeholder participation and adaptation priorities identified on the basis of political consensus and sound science.

Several adaptation activities may be coordinated at the regional level in Asia. These include (i) creating a more consistent framework for adaptation and guidelines for mainstreaming adaptation concerns in all policy areas; (ii) a regional adaptation facility to identify and finance projects of regional significance; (iii) developing a common reporting mechanism on adaptation strategies and measures; (iv) disseminating success stories from databases containing examples of adaptation actions and options; (v) coordinating adaptation measures for transboundary issues such as river basin management; and (vi) capacity strengthening, education, and related efforts aimed at raising public awareness. Ongoing regional and sub-regional initiatives (e.g. Association of South East Asian Nations [ASEAN] peat land management initiative) can be a good starting point.

4.2.2. Mainstreaming adaptation concerns into development planning

Adaptation to climate change will have an impact on many policy areas in Asia. Therefore, strategies to integrate adaptation in existing and upcoming legislation and policies are crucial. In many Asian countries, the need for mainstreaming climate concerns is acknowledged, but progress is slow due to difficulties in finding appropriate points of intervention. Several barriers have been identified, including information barriers, lack of incentives and institutions, limitations on human and financial resources, lack of coordination among government agencies, lack of communication between the climate change community and development community, and insufficient knowledge and analytical tools (Warrick 2000; Agrawala 2004; OECD 2005; OECD 2006; Srinivasan 2006a). A thorough assessment of obstacles that take into account country-specific and site-specific considerations is necessary for effective mainstreaming. The preparation of a NAPA type document in all countries, with multi-stakeholder inputs, may help in determining adaptation priorities and suitable means to

integrate such concerns in development planning. Practical demonstrations of promising mainstreaming options, capacity strengthening and streamlining of financial mechanisms are also crucial to making further progress.

Uncertainties regarding future climate change impacts at the national and local levels and the lack of relevant local information necessary for adaptation planning are also major obstacles to the development of effective adaptation actions. For example, in many critical coastal ecosystems in Asia, detailed vulnerability and adaptation assessments have not been completed as most countries do not have detailed topographic maps with sub-meter contours, which are crucial for planning for sea level rise. Also, the detailed down-scaled climate change projections, a prerequisite for adaptation planning, are often unavailable. Increased focus is necessary on data collection, development of enhanced regional and local climate change scenarios, vulnerability mapping, hazard and risk assessment, disaster management and evacuation plans, and databases on good adaptation practices. Developing related scientific tools (e.g. revised building codes, new standards for infrastructure engineering, improved material testing) should also be encouraged. Thus, mainstreaming adaptation concerns into the development agenda in Asia must be pursued based on thorough assessments of current vulnerabilities and opportunities and pitfalls of such integration in each locality.

Mainstreaming adaptation concerns is crucial not only in agriculture and water management but also in sectors such as health, tourism and infrastructure development. A prime example of the immediate need for adaptation is buildings; enforcement of building codes which take into account future impacts of climate change is a completely new area in Asia. Likewise, new transport infrastructure should be made climate proof from the early design phase (box 2.4).

Box 2.4. Adaptation of the Qinghai-Tibet railway to climate change

The Qinghai-Tibet Railway crosses the Tibetan Plateau with about a thousand kilometres of the railway at least 4,000 metres above sea level. Five hundred kilometres of the railway rests on permafrost, with roughly half of it “high temperature permafrost” that is only 1-2°C below freezing. The railway line would affect the permafrost layer, which will also be impacted by thawing as a result of rising temperatures, thus in turn affecting the stability of the railway line. To reduce these risks, design engineers have put in place a combination of insulation and cooling systems to minimise the amount of heat absorbed by the permafrost (Brown 2005).

Source: IPCC (2007)

The national meteorological services in Asian countries should be strengthened and reoriented to provide policy relevant information regarding adaptation. In addition, legal provisions to mainstream adaptation concerns into management choices could be strengthened. For example, standard environmental impact assessments (EIA) often consider the impacts of the potential project on the environment. In the future, EIAs should also include a section on how current and future impacts of climate change can affect the sustainability of the project and detail measures to overcome these impacts.

The lack of information on the cost-effectiveness of adaptation options and potential synergies with other initiatives are also constraints to mainstreaming adaptation (Srinivasan 2008). All developmental policy measures should undergo an adaptation screen to ensure that they do not enhance vulnerabilities in the long run. For example, policies to promote tourism and the necessary infrastructure in vulnerable areas of coastal zones should consider the projected impacts of climate change in order to avoid mal-adaptation. Likewise, it is important to ensure that development assistance by donors undergoes an adaptation screening to ensure "climate proofing" of externally funded investments.

Donor agencies could facilitate adaptation mainstreaming by screening their project portfolio for potential climate change impacts, and by creating an enabling environment for adaptation mainstreaming through (i) development of operational guidelines; (ii) provision of detailed down-scaled climate projections; (iii) additional support for monitoring and evaluation of mainstreaming approaches; and (iv) enhancing the technical skills for mainstreaming at the sectoral level. The UNFCCC and other international organisations can play a catalytic role in the exchange of experiences, and in facilitating the development of region-wide and sector-wide approaches for mainstreaming. Some progress along these lines is evident already. For example, the Development Assistance Committee of OECD has begun to look at ways to integrate adaptation into EIA and strategic environmental assessments. Similarly, agencies such as the World Bank have begun to use tools (e.g. ADAPT - Assessment and Design for Adaptation to Climate Change: a Prototype Tool) to screen proposed development projects for potential risks posed by climate change.

4.2.3. Harnessing indigenous coping strategies

Asia is a rich reservoir of indigenous knowledge (also referred to as traditional local knowledge), which is unique to local communities and is acquired through local people's experience and observations of their surrounding natural systems (Srinivasan 2004). Since adaptation is often a complex process that requires detailed site-specific considerations, any adaptation measure must effectively utilise or be built on indigenous coping strategies. While not all indigenous practices are necessarily sustainable, successful adaptation typically requires knowledge of local risk factors for extreme climate events, as well as flexible production and income strategies in response to such events (Shaw 2006). Many indigenous coping strategies are known to enhance adaptive capacity (table 2.11) but very few of them have been integrated into national or local adaptation planning in Asia, perhaps due to insufficient recognition of their value and bias against local knowledge. Indeed, many local ways to cope with climate extremes, which were once considered primitive and misguided, are now seen as appropriate and sophisticated. Field surveys in flood-prone and drought-prone areas of Bangladesh revealed that indigenous coping strategies still remain the most reliable and sustainable forms of disaster response (Srinivasan 2004). Effective integration of local coping strategies into adaptation plans, however, requires a thorough assessment of strengths and weaknesses of each strategy, as some are no longer adequate to cope with impacts of climate change.

Realizing the importance of local knowledge and involvement of local communities in successful adaptation, there is a growing interest in international institutions to support community-led initiatives on adaptation or proactive micro-adaptation. For example, in 2003, the UNFCCC initiated a database of local coping strategies for adaptation to disseminate information to a wider audience.¹⁷ The Global Environmental Facility (GEF), through its small grants programme, supports community-oriented adaptation

projects in which local knowledge is duly considered. If other bilateral and multilateral donor agencies can preferentially support collection and integration of local knowledge in adaptation planning, the prospects for improved adaptive capacity will be enhanced.

Table 2.11. Examples of indigenous coping strategies

Location	Indigenous coping strategy
	<i>Coping strategies for floods and heavy rainfall</i>
Manikganj (Bangladesh)	Growing catkin in sandy lands to prevent erosion, and constructing manchans (hanging bamboo platforms inside houses)
Matalom (the Philippines)	Kahun-Kahun (a soil conservation technique to reduce the impact of heavy rainfall)
Mountainous regions of Nepal	Ploughing sloping lands in a sward-like pattern to minimise soil erosion
	<i>Coping strategies for droughts</i>
Kerala (India)	Surangas (man-made caves for water)
Karnataka (India)	Madakas (traditional percolation ponds)
South India	Planting <i>Sesbania grandiflora</i> on the edges of long trenches to increase humidity for betel vine gardens

Source: Adapted from Srinivasan (2004)

4.2.4. Broadening the funding base for adaptation

There is a wide gap between the necessary levels of funding for addressing adaptation in developing countries and the funds currently available. Recently, UNDP estimated that the additional costs of adaptation in developing countries would be as high as \$86 billion per year by 2015 (UNDP 2008). Likewise, the World Bank estimated that \$10-40 billion per year would be necessary to adequately address adaptation needs, while the funds under the current climate regime are less than \$200 million. The available amounts are not even adequate for addressing high priority adaptation measures identified by LDCs in their NAPAs. For example, five LDCs (Bangladesh, Bhutan, Cambodia, Samoa and Tuvalu) in the Asia-Pacific region reported that they would require as much as \$114 million to cover the costs of priority adaptation measures (table 2.12). Given the wide gap between requirements and supply, existing publicly available funds have to be utilised to finance adaptation projects. In addition to public funds, the role of the private sector (e.g. insurance) will be increasingly important.

IGES reviewed about 30 proposals on adaptation, including those related to adaptation financing. Most proposals are based on ideas of historical responsibility, ability to pay, and the “polluter pays principle.” Some proposals seek to create new and specialised funds (Government of Tuvalu 2005; TERI 2005; ICCTF 2005; Müller 2002; Oxfam 2007). The proposal by Tuvalu, for example, identifies various means to diversify and enhance adaptation funds (solidarity fund and insurance fund to be supported by a levy on fossil fuel sales in Annex I countries). TERI’s proposal incorporates the convention’s guidance to provide new and additional financing besides compensatory financing. Other proposals suggest improving the flexibility of access to (Parry et al. 2005), or enlarging the scope (Bouwer and Aerts 2006) of, adaptation funds. In past negotiations, several developing countries proposed that a levy be imposed on transactions under all three Kyoto mechanisms, while many others opposed an extension of the levy beyond CDM.

Table 2.12. Costs of priority activities of adaptation in selected LDCs in the Asia-Pacific region

Country	Adaptation measure	Cost (\$ million)
Bangladesh	Construction of flood shelters, and information and assistance centres to cope with more frequent and intense floods in major floodplains	5.00
	Enhancing the resilience of urban infrastructure and industries to the impacts of climate change	2.00
	Promoting adaptation of coastal crop agriculture to salinity	6.50
	Adaptation of fisheries in areas prone to enhanced flooding in the Northeast and Central Regions through adaptive and diversified fish culture practices	4.50
Bhutan	Landslide management and flood prevention	0.89
	Weather forecasting system to serve farmers	0.42
	Flood protection of downstream industrial and agricultural areas	0.45
	Rainwater harvesting	0.90
Cambodia	Rehabilitation of upper Mekong and provincial waterways to reduce risks caused by floods, improve fishery resources, and supply sufficient water for irrigation and domestic uses	30.00
	Vegetation planning for flood and windstorm protection	4.00
	Development and improvement of community irrigation systems	4.00
	Community mangrove restoration and sustainable use of natural resources	1.00
Samoa	Reforestation, rehabilitation and community forestry fire prevention project	0.42
	Climate early warning system project to implement effective early warnings and emergency response measures to climate and extreme events	4.50
	Coastal infrastructure management plans for highly vulnerable districts	0.45
	Sustainable tourism that takes into account climate change and climate variability	0.25
Tuvalu	Increasing resilience of coastal areas and settlement to climate change	1.90
	Increasing pit-grown pulaka productivity through introduction of a salt-tolerant pulaka species	2.20
	Adaptation to frequent water shortages through increasing household water capacity, water collection accessories, and water conservation techniques	2.70

Source: Adapted from NAPAs submitted to the UNFCCC

Three related groups of proposals focus on funding to reduce climate change risks. Jaeger (2003) proposed creating a fund based on a levy from emissions trading to buy insurance for adaptation costs and damage compensation. Providing insurance was also central to proposals from AOSIS (specifically to small island low-lying nations for the gradual expected sea-level rise), Germanwatch (against extreme weather events), and the International Institute for Applied Systems Analysis (IIASA) (two-tier insurance scheme). While the AOSIS and Germanwatch proposals seek contributions solely from developed countries, the IIASA proposal seeks contributions from both developed and developing countries (Bals et al. 2005). Other risk management schemes such as an insurance pool, catastrophe insurance or micro-insurance (Parry et al. 2005) and risk transfer instruments such as catastrophe bonds (Hamilton 2004), weather derivatives (Figueres 2005) and weather hedges (Linnerooth-Bayer et al. 2003) were also

proposed to finance adaptation efforts in developing countries. Müller and Hepburn (2006) offered a proposal entitled “international air travel adaptation levy” (IATAL) that could attract as much as \$4-10 billion per annum. The proposal aims to link the adaptation challenge with a policy for regulating rapidly increasing aviation emissions, and is unique in that it proactively involves the private sector. A modified aviation levy proposal with differentiated burden sharing and fund sharing mechanisms was proposed in recent IGES consultations (Srinivasan 2008).

An assessment of the current financial instruments available to support adaptation in Asia suggests that the amount of resources flowing through such instruments is inadequate. Therefore, options to be examined include (i) enlarging the funding base for adaptation both within and outside the UNFCCC; (ii) involving the private sector (e.g. insurance sector) in facilitating adaptation at the regional, national and local levels; (iii) establishing a region-wide adaptation fund which can be financed, for example, by levying a tax on FDI flowing into the region since it can be seen as outsourcing energy-intensive industrial processes to developing Asia; and (iv) establishing a region-wide insurance facility hosted perhaps at the ADB.

Building synergies of adaptation plans with disaster risk management and MDG achievement plans, developing flexible, customised credit schemes (including microfinance), and providing alternative climate-insensitive income generating activities, can help increase adaptive capacity in Asia. Robust insurance mechanisms, including an “Asian catastrophic risk insurance facility”, may be needed to enhance vulnerability and adaptation assessments and promote public-private partnerships in adaptation.

In the short-run, developed countries should play a major role in providing assistance for enhancing regional cooperation in adaptation. For example, Japan can take initiatives in facilitating the development and transfer of adaptation-related technologies, developing new insurance products and a regional insurance scheme, and establishing an innovative adaptation fund in Asia. However, all efforts at national and local levels must aim at making adaptation a self-sustaining mechanism in the long run.

4.3. Harnessing the potential of market mechanisms

The use of market mechanisms for environmental protection has received considerable attention in the UNFCCC and its Kyoto Protocol. The Kyoto Protocol uses three types of market mechanisms to limit GHG emissions – international emissions trading, joint implementation (JI) and CDM. At least five elements are considered essential for providing environmental and economic integrity in such mechanisms: measurement, transparency, accountability, fungibility, and consistency (Petsonk et al. 1998). In developing Asia, the only market mechanism in use is the CDM, which aims at promoting GHG emissions reductions and sustainable development in developing countries, while enabling flows of technology and finance from developed countries in return for emission reduction credits.

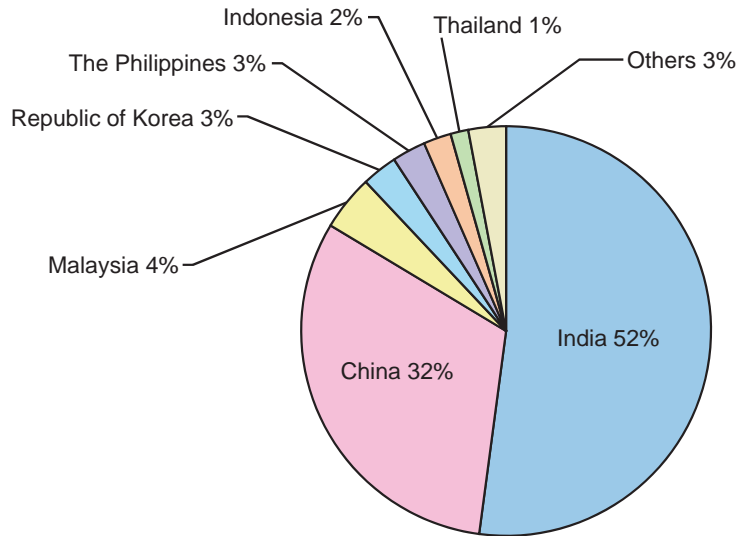
Following the entry into force of the Kyoto Protocol in February 2005, the CDM market has grown rapidly in Asia. The mismatch between the supply and demand of CERs, approval of the decision on unilateral CDM, and the launch of the European Union's (EU) emission trading scheme (ETS) linked with CDM/JI have helped trigger this dramatic growth. Despite such expansion, there are still several barriers preventing the CDM from realizing its full potential in the region.

4.3.1. CDM implementation in Asia

By 1 May 2008, the CDM Executive Board (CDM-EB) registered 1035 CDM projects with an expected delivery of more than 1.27 billion CERs by 2012, of which about 140 million CERs have been issued by host countries. If all the 3,000 projects in the pipeline actually materialise, more than 2.7 billion CERs (tCO₂e) will be issued by 2012 (UNFCCC 2008). Out of 1035 registered CDM projects, 641 were in the Asia-Pacific region, accounting for 62% of the total number of projects and 77% of the total CERs. Within Asia, India and China have 84% of total registered projects and 85% of CERs through 2012 (74% of 111 million CERs issued to date were from projects based in China and India). India has the largest share of registered CDM projects (fig. 2.3), while China has the largest share of CERs (fig. 2.4) (IGES 2008; UNEP-RISO 2008).

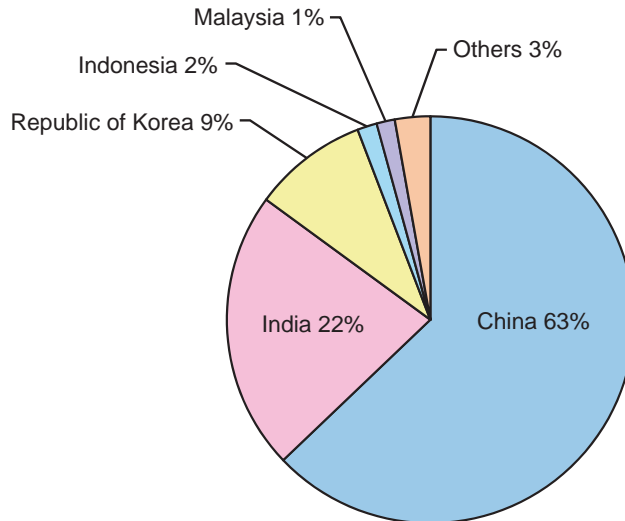
Serious concerns about CDM implementation include (i) the limited attention to environmental integrity (whether CDM emissions reductions are really additional to what would have happened in the business as usual [BAU] scenario); (ii) the uncertainty surrounding post-2012 CER credits; (iii) the ineffectiveness of the CDM-EB; (iv) the slow approval of CDM projects; and (v) the uneven geographical distribution of CDM projects.

Figure 2.3. Distribution of various CDM projects in Asia by country (as of May 2008)



Source: IGES CDM project database (<http://www.iges.or.jp/en/cdm/report.html>)

Figure 2.4. Distribution of CER volumes through 2012 from CDM projects in Asia by country (as of May 2008)



Source: IGES CDM project database (<http://www.iges.or.jp/en/cdm/report.html>)

The geographic inequity in CDM is a major concern to many LDCs and SIDS in the region, as most of the CDM projects are in China, India, and the Republic of Korea. Only one project was registered in Bhutan, Cambodia, Fiji, Lao PDR, Pakistan and Papua New Guinea, while there were no registered projects from Maldives, Myanmar, and Singapore even though they have established DNAs. The LDCs with greatest development needs have therefore received the fewest projects.

Cumbersome CDM modalities and procedures and high transaction costs pose major barriers to the development of CDM projects. For example, a CDM project developer needs to justify additionality (how the CDM project reduces GHG emissions below those in a BAU scenario and why the project cannot be implemented without CDM revenue). Also, the methodology to calculate baseline emissions must be approved by the CDM-EB.

Uncertainty about the value of CERs after the first commitment period of the Kyoto Protocol is a concern, especially for private investors. Although most CDM projects have crediting periods that go beyond 2012 and CERs can be accumulated for up to 21 years, the current uncertainty about the post-2012 climate regime has dampened demand for post-2012 CERs (Egenhofer et al. 2005; UNFCCC 2006).

Another criticism of the CDM is that its contribution to promoting sustainable development in developing countries is limited (Lohmann 2006; Olsen 2007). For example, afforestation/reforestation (A/R) CDM projects which could contribute to sustainable development in local areas have not been realised, as only one A/R CDM project has been registered to date. Likewise, projects with large sustainable development benefits provide only a few CERs (and therefore receive less investment funds). For example, while 55% of the CDM projects are based on RE, they only

accounted for 29% of the CERs. EE takes 14% of the CERs for the supply-side EE and only 1% for the demand-side EE. On the other hand, HFC, PFC and N₂O projects were only 2.4% of the total number of projects but contribute nearly 29% of the total volume of CERs by 2012 (UNEP-RISO 2008). The latter projects score much lower on measures of social and environmental development than more sustainable CDM projects such as RE projects (Cosbey et al. 2006). Based on a review of the environmental and development benefits of 10 illustrative CDM projects, Boyd et al. (2007) found that there was no causal relationship between project types and sustainable development outcomes. Also, it can be misleading to assess project performance only through project documentation, as they may conceal local struggles and other development and climate mitigation alternatives. For example, sponge iron projects in India have been criticised for putting pressure on local villages to sell their land and appropriating local water resources for the expansion of company facilities (Lohmann 2008). Studies in China suggest that CDM has had very little impact on key drivers of China's GHG emissions growth, especially in sectors such as coal-fired power generation, transportation and buildings.

4.3.2. Prospects for reforming market mechanisms

(i) Short term

Strengthening human and institutional capacities and improving institutional and operational settings to implement CDM — Many barriers to CDM can be overcome through strengthening institutional and operational settings. An early signal on continuing CDM beyond 2012 is important in the Asia-Pacific region because CDM activities have only recently begun to pick up pace, and many projects in the region have long gestation periods with high capital costs. If CERs continue to have value through an increased demand for credits, it can lead to sustained implementation of CDM projects. Recently, the World Bank decided to launch "Carbon Market Continuity Fund" to provide some assurance to the post-2012 credits.

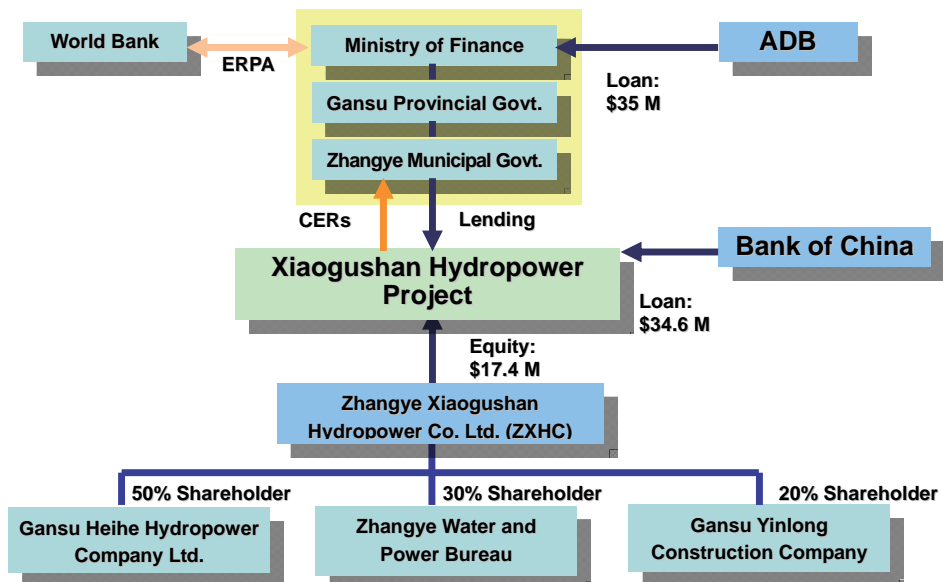
In addition to providing a strong signal that the CDM will continue beyond 2012, complex CDM modalities and procedures as well as high transaction costs of project implementation need to be addressed. In the IGES capacity-building programme, it was found that the frequent updating of rules and procedures was an obstacle to effective CDM project development. Ensuring that the international regime operates on simplified modalities and procedures and national level agencies have sufficient human and institutional capacities will make it easier to take advantage of the CDM in future. In addition, creating databases for baseline calculations by national governments and/or international agencies would reduce transaction costs greatly (Michaelowa 2005).

Using ODA and other multi-source funding approaches to cover CDM risks and underlying project finance, especially in LDCs and middle-income countries, to improve geographic equity — Another major barrier to effective implementation of CDM projects is the lack of underlying finance. To overcome this barrier and enhance the prospects of obtaining up-front payments for project development, synergies between the private sectors of Annex I and non-Annex I countries should be strengthened through bilateral business agreements. In addition, adequate steps should be taken to strengthen capacity and increase awareness of the CDM in both public and private financial institutions of developing countries so that the underlying finance may be secured domestically (Masuda 2005).

Another option to address this financial barrier is the use of ODA for the CDM, although diverting ODA to purchase CERs is not allowed under the current regulation of the CDM (there is a concern that using ODA to purchase CERs will reduce funds allocated to other developmental activities such as education). Providing ODA, especially during the initial stages of CDM implementation, is critical. In this context, Japan's decision in January 2008 to use ODA to implement CDM projects (but not for purchasing CERs) in China is a significant development. ODA can also improve the prospects of bringing investments in LDCs and SIDS, which are not financially attractive to investors. In countries with high risks, ODA coupled with export credit insurance may also be used to mitigate risks. A key requirement is to combine climate change outcomes with sustainable development objectives in project designs.

Multi-source funding can promote CDM projects by sharing risks among several financial institutions so that project owners can receive up-front payments relatively easily (de Gouvello and Coto 2003). Multilateral financial institutions and development agencies can act as catalysts to generate multi-source funding for CDM projects. For example, the Xiaogushan Hydropower Plant Project in China received loans from the Bank of China (39.8% of the total cost) and the ADB (40.2% of the total cost) for implementation, based on an emissions reduction purchase agreement (ERPA) signed with the World Bank (World Bank 2004). The equity contributions of the project owner covered the remaining 20%. Explicit guarantees from the Gansu Provincial Government and the Zhangye Municipal Government also facilitated the loan agreement (fig. 2.5).

Figure 2.5. Multi-source funding structure of the Xiaogushan hydropower project in China



*(ii) Medium term****Widening the scope of CDM to include sector-based approaches, including those sectors not yet covered by the Kyoto Protocol (aviation, deforestation, etc.)*** —

The COP/MOP and CDM-EB agreed in 2006 to register programmatic CDM (“project activities under a programme of activities [PoA]”) as a CDM project if approved baseline and monitoring methodologies are used to define project boundaries, avoid double-counting and account for leakage. The PoA-type CDM may facilitate implementation of small-scale projects, which are often beneficial to local communities by improving the quality of life in developing countries. However, local/regional/national policies or standards are not yet accepted as CDM. A “sectoral CDM” has been suggested to widen the scope of project-based CDM (Samaniego and Figueres 2002) and several variations have been proposed such as policy-based, intensity-based and cap-based sectoral CDM (Bosi and Ellis 2005). Widening the scope of CDM could considerably increase supplies of CERs while effectively cutting down on transaction costs and offering least-cost mitigation opportunities to Annex I countries. Through sector-based CDM, synergies with sector-based national development plans in Asian countries can also be identified and exploited.

Another potential advantage of a sectoral CDM is that it can increase opportunities for CDM development in LDCs and SIDS and thereby redress the geographical inequity that currently characterises the CDM. Since CDM is a voluntary market-based mechanism, private sector investment activities have tended to gravitate to countries where transaction costs and investment risks are low. For the same reasons, investments have also tended to flow to projects that promise to generate substantial amounts of CERs. Most CDM projects in LDCs and SIDS lack these qualities; that is, they are typically small projects with relatively few CERs and are perceived as having high transaction costs. A sectoral CDM, therefore, can generate more CERs, reduce transaction costs, and provide significant benefits to underrepresented regions.

Broadening the CDM permits inclusion of sectors which are not yet covered by the Kyoto Protocol and related international regimes: i.e. aviation, maritime emissions, deforestation avoidance, etc. For example, GHG emissions from deforestation attracted a considerable amount of attention but deforestation in developing countries is not yet covered in the current CDM. Broadening the CDM to include these additional sectors can facilitate participation in mitigation activities from these key sectors and consequently address sectoral inequities in the CDM. Several schemes to address the issue of “reducing emissions from deforestation and degradation (REDD),” including the creation of a separate market (Ogonowski et al. 2007; Environmental Defense 2007), have been proposed and are discussed in detail in Chapter 4.

Promoting developmental benefits of CDM projects through quantifying and preferentially rewarding such benefits —

Although one of the primary objectives of the CDM is to contribute to sustainable development in host countries, the majority of CERs come from projects with significant GHG emission reductions but few development benefits (Boyd et al. 2007). To correct this imbalance, a necessary first step is to strengthen the assessment of how a CDM project contributes to sustainable development. Current screening methodologies are based solely on the host country's assessment criteria and approval processes. More often than not host countries do not place a premium on projects with high development benefits or discount those that might conflict with sustainable development principles. Several proposals have been advanced to rectify this situation. For instance, if CDM-EB required that the host

country's criteria for assessing development benefits be validated by a third party, it could compel project developers to be more receptive to securing developmental co-benefits. However, adding extra burdens to the approval process and high transaction costs already evident in the project-based CDM would have to be avoided.

In addition to third party validation, providing greater incentives to consider developmental co-benefits is crucial. As current rules do not compel project developers to seek out projects with the highest sustainable development benefits, the CDM-EB should create an incentive-based framework that would accommodate sustainable development benefits within the existing CDM. Sustainable development co-benefits from CDM projects ought to be quantified and financially supported separately, for example, by ODA, CSR funding or benevolent funds, so that the total value of the projects with significant sustainable development benefits could out-compete those with high CERs alone (Hiraishi 2005). Quantifying the sustainable development benefits of projects and issuing different types of credits for "sustainable" CERs could attract companies that take CSR seriously. Projects with high CERs should be carefully re-evaluated to capture all the sustainable development benefits or to evaluate secondary impacts of CDM (Kolshus et al. 2001). A voluntary standard such as the "CDM Gold Standard" can help in realising sustainable development benefits of CDM.

Self-assessment by project developers using various tools, such as an additionality tool for sustainable development, or an economic internal rate of return with qualitative indicators that capture non-monetary quantitative indicators (Motta et al. 2002) may also be helpful. Another way to ensure that developmental co-benefits are realised is for the COP/MOP and CDM-EB to impose a form of taxation on projects with low sustainable development benefits and then allocate the collected revenue to projects with high sustainable development benefits. Application of a differentiated levy to various projects, depending on their contribution to sustainable development, would help to promote projects with high sustainable development benefits (Muller 2007). Establishing a global point system and ensuring that all projects have to reach a minimum number of points for sustainable development benefits to be accepted by the CDM-EB has also been suggested. A scheme under which certain types of projects in key regions or sectors could gain double or triple CERs while others generating few sustainable development benefits would be awarded half or a third of the number of CERs currently awarded has also been suggested. However, an international agreement on policy-based adjustments to CERs or intentional distortion of the emerging carbon market is not easy to achieve.

(iii) Medium to long term:

Involving developing Asia in schemes to promote low carbon economies — A more conducive domestic policy environment is needed to harness the potential of market mechanisms and FDI to promote a low carbon economy. Domestic developmental, energy and related policies should include provisions to support such market mechanisms. Initiatives to develop local and national allowance-based mechanisms (i.e. local and national ETS) in the Asia-Pacific region would also be beneficial in furthering this agenda. More concretely, the establishment of an Asia-based ETS would ease the process of integrating local, national, and eventually international ETS. In this light, the development of domestic CDM projects such as those being promoted by the Republic of Korea alongside the development of domestic ETS is encouraging as such experience will facilitate carbon trading in the region.

Current estimates of CDM project development suggest that as much as 2.7 GtCO₂e emissions may be reduced by 2012, if all projects in the pipeline are implemented successfully. Although the amount is substantial, it is still far too small to make a significant reduction in the GHG emission trajectories of developing countries. For example, annual fossil fuel based emissions from developing countries are expected to double from the current 10 to 20 GtCO₂e in 2030. Therefore, other types of market mechanisms are needed to complement the CDM. Project-based approaches are not always applicable to many sectors such as transportation and households. To facilitate participation from those sectors, different incentive and disincentive mechanisms must be utilised (e.g. international carbon tax system, promotion of venture capital funds, or payment for ecosystem services). New special funds from multilateral financial institutions, such as the World Bank, will also help to realise the full potential of market mechanisms. Experience gained through operating the Prototype Carbon Fund, Community Development Carbon Fund, Biocarbon Fund, and others needs to be documented and built on. The launch of the World Bank's Carbon Market Continuity Fund (to ensure the value of post-2012 CERs) and Carbon Partnership Facility should stimulate fuller utilization of market mechanisms for climate protection.

There has been a dramatic expansion of voluntary carbon markets and the trend is likely to continue in the future (box 2.5). Expansion of these markets is due to the heightened awareness of individuals and companies of climate change and the consequent willingness to offset GHG emissions from their activities through the procurement of voluntary carbon credits. Voluntary carbon offsets may be used to transfer resources that will allow communities to leverage benefits locally. If the voluntary market is to continue to grow, however, minimum institutional arrangements should be put in place to enhance its credibility. Environmental education or other awareness raising measures will also help the market's development.

The Chicago Climate Exchange (CCX) held its first auction of CERs in September 2007. The auction was for 163,784 CERs issued by the UNFCCC to a wind energy farm in western India. The clearing price was \$22.11 per tCO₂e, which was \$1.00-\$3.00 less than the CER futures contract price in Europe. The sale was a clear indication that the CCX is expanding to include more options for buyers than its voluntary emissions reduction (VER) dominated market. Likewise, some airline companies have begun to launch carbon offset schemes linked to CDM. For example, British Airways launched a scheme in January 2008, allowing customers to offset GHG emissions from their air travel by funding clean energy projects developed under CDM.

Several ideas may be considered to improve the cost-effectiveness and the environmental integrity of market mechanisms in Asia. For example, CDM could be abolished after 2012 to be replaced by another mechanism, if it is proved that the CDM did not lead to net global emission reductions. Likewise, selected sectors or countries may be retired from CDM (CDM sunset) to promote CDM in other sectors and countries, which have not benefited from CDM to date. Premium emission budgets could ensure full access to the carbon market in return for voluntary commitments from developing countries (Environmental Defense 2007). In this scheme, any reduction in emissions below current levels would be tradable, and reductions not sold during the premium budget period can be banked for the future. Another variant—value-added CDM on demand and supply sides—was also suggested. For value-added CDM on the demand side, an entity in an Annex I country has to retire 10 CERs for every 100 CERs bought from developing countries. Similar value-added ratios worked well under the US Clean Air Act. Value-added CDM on the supply side enables major developing

Box 2.5. Development of voluntary carbon markets

Recently the voluntary carbon market has grown dramatically, although it is still a small fraction of the size of the regulated markets such as CDM and JI. In 2007, a total volume of 65 MtCO₂e with a value of \$331 million transacted in the voluntary carbon market, which represented a tripling of transactions in 2006. Asia's share of projects in the voluntary market increased from 22% in 2006 to 39% in 2007. The price for credits showed a huge variation, ranging from \$1.80 per tCO₂e to \$300 per tCO₂e (Hamilton et al. 2008).

The buyers of voluntary market credits are typically individuals that wish to offset lifestyle-related GHG emissions (residential energy use, commuting, travel), consumer-oriented companies that wish to offset operational-related GHG emissions, and high emitting companies that wish to voluntarily offset GHG emission that they cannot easily reduce through changes in their production processes (World Bank 2007). For companies, there are numerous drivers behind their involvement in the voluntary market, but CSR and familiarity with the market in anticipation of it being incorporated in the future climate regime appear to be the most important.

The voluntary market also has some unique features that distinguish it from the CDM. Chief among these is that the voluntary market covers projects from underrepresented sectors. A recent survey, for instance, found that forestry projects accounted for 36% and RE projects account for 33% of total projects. The predominance of forestry credits is derived from not only the regulation of the compliance market (i.e. rules of CDM and EU-ETS) but also perceived sustainable development benefits of these projects, which many voluntary buyers find attractive (Hamilton et al. 2007).

While these are encouraging signs, the credibility of the voluntary carbon market must be enhanced if it is to have more than a modest impact. To do so, the markets would need to introduce uniform standards of voluntary credits and verification from independent third parties that funds were actually used for their intended purposes. The current lack of a universally acceptable voluntary standard for emission reduction seems to be a significant impediment to the voluntary market's further expansion (World Bank 2007). Several promising standards have already been proposed, such as the Gold Standard by 51 NGOs/ charitable organizations and the Voluntary Carbon Standard by the International Emission Trading Association (IETA).

economies to apply the value-added ratio to their own CERs, and withhold a portion of CERs from the market. Putting quantitative limits on CER imports by Annex I countries was also suggested as a means to force Annex I countries to realise emission reductions within their own borders.

4.4. Implementing policies with multiple climate and developmental benefits, and measures to realise a low carbon society in the future

4.4.1. Developmental co-benefits in Asia

There is a heightened interest in making GHG mitigation strategies compatible with national sustainable development priorities. Policies that can concurrently mitigate global and local pollutants are sought. Rather than exclusively targeting the abatement of GHGs, integrated policy measures promise to deliver “co-benefits” (implied in Nordhaus 1991; estimated in Ayres and Walter 1991; explained in Krupnick et al. 2000). Co-benefits are the locally desirable and additional sustainable development benefits (e.g. improved air and water quality, enhanced energy security, reduced land use impacts, reduced congestion, improved traffic safety, increased income to rural communities, protection and preservation of biodiversity) that would accompany climate actions in various sectors such as transportation, agriculture, forestry, industry and infrastructure.¹⁸

Some co-benefit studies have shown that the benefits of climate actions can reach more than 2% of GDP in cities such as Beijing (He 2003).¹⁹ Such co-benefits can offset the costs of even aggressive climate measures, and do so by a wide margin. Unfortunately, co-benefit studies in Asia have been limited to analytical inputs for a handful of policy decisions (IGES 2007). To promote the linkage between sustainable development co-benefits and climate change actions, the following measures should be considered.

(i) Raising awareness of developmental co-benefits

In the short term, policymakers in Asia should become more cognizant of the linkages between sustainable development and GHG mitigation, especially in Asia’s rapidly growing (e.g. energy, transportation, commercial buildings) and climate-sensitive (e.g. water, agriculture, land use/land use change/forestry) sectors. Underlying the lack of awareness is the widely held misperception that mitigating GHGs is incompatible with sustaining development. This misperception needs to be changed soon.

Fortunately, the misperception should be easy to correct in developing Asia. Numerous integrated sustainable development policies and measures already exist in the region. Many of these integrated policies deliver non-health co-benefits. That is, rather than simply improving air quality and public health, they also make other contributions to local and national development. For instance, China has introduced a total emissions control plan that is intended to mitigate sulphur dioxide, lessen the impacts of acid rain, and boost crop yields; the total control plan, if implemented effectively, will also reduce carbon emissions (Aunan et al. 2007). The Philippines Clean Air Act could reduce traffic congestion and commuting times, in addition to mitigating GHGs (Subida et al. 2004). Co-benefits can come from a wide range of measures, including but not limited to (i) EE, RE and energy conservation policies; (ii) land use and community forestry practices; and (iii) sustainable transportation and fuel efficiency initiatives.

Policymakers must not only become aware of co-benefits but also realise that measures to mitigate GHGs lie at the core of many of the developmental challenges confronting the region. This conceptual shift will require both a heightened appreciation of co-benefits and a broadening of the concept. Because most studies rely on methods

that estimate health-related co-benefits (focusing on the link between improved local air quality and various health endpoints), non-health endpoints such as improved energy security and technology transfer have been underemphasised in co-benefit research. New techniques for estimating sustainable developmental benefits need to be developed. Policymakers need to be encouraged to consider the full range of benefits (and costs) that flow from climate actions.

Expanding the concept of co-benefits will not only raise awareness, but also help to situate co-benefits in a wider range of policy debates and lead to a greater consideration of climate benefits in sustainable development planning. Mainstreaming co-benefits into sustainable development planning would also reduce the risks of climate plans being “orphaned,” or relegated to a single ministry with insufficient leverage.

(ii) Building institutions to recognise and reward co-benefits

In the medium term, national and international institutions are needed to scale-up co-benefits and overcome barriers to implementing integrated policies. Limited administrative capacity, inter-agency coordination problems, and opposition from vested interests—the same barriers that undermine the implementation of regulatory initiatives in much of the developing world—may also frustrate the realization of co-benefits (Janicke and Weidner 1997; Desai 1998; Pearce 2000).

Some effort to overcome these barriers might be taken at the national level. As domestic policymakers become more familiar with developmental co-benefits, they may consider constructing databases of integrated policies, such as the one being developed by the World Resources Institute (WRI 2008), and devising nationally-suitable metrics to assess the sustainable developmental contribution of these policies. However, much of the impetus for these international efforts should come from a post-2012 climate regime that recognises and rewards co-benefits. In building such a regime, climate negotiators should review the operational features of bottom-up post-2012 regime proposals such as the SD-PAMs (table 2.13) that would enable developing countries to pledge integrated policies (Winkler et al. 2002; Baumert and Winkler 2005; South Africa 2006). Climate negotiators should consider building a standardised set of tools and procedures to estimate the value of co-benefits into the post-2012 regime (such as the IISD developmental dividend, the CDM Gold Standard, or the UNEP Risø Centre COSI tool) (Cosbey et al. 2006; CDM Gold Standard 2007; Olsen 2007). Consideration of these tools and procedures should take into account the tension between using rapid assessment techniques to scope the development benefits of integrated policies against more rigorous methods for measuring these benefits. A possible resolution to this tension would be allowing national policymakers to conduct a preliminary evaluation of developmental benefits with less rigorous scoping methods and then delegating authority to a certifying body within the UNFCCC to use more rigorous evaluation techniques if initially scoped estimated benefits prove controversial.

Table 2.13. Step-wise implementation of SD-PAMs in an international climate framework

1	Country outlines future development objectives.
2	Identification of PAMs to achieve development objectives more sustainably. PAMs may be new policies or policies that are not fully implemented.
3	Mobilise investment and implement SD-PAMs.
4	Recording SD-PAMs in a registry (e.g. maintained by the UNFCCC secretariat).
5	Setting up a national monitoring system to track the implementation of SD-PAMs.
6	Review of SD-PAMs in SD units, either as part of a NC or a specific review.
7	Quantifying the changes in GHG emissions from individual PAMs.
8	Identifying PAMs with synergies or conflicts between sustainable development benefits and GHG mitigation.
9	Summarizing the net impact of SD-PAMs on development and GHG emissions.

Once co-benefits are reliably measured, they should be rewarded. Policymakers and climate negotiators should consider incentives that are most likely to help overcome the barriers to achieving developmental benefits. Three kinds of incentives are likely to prove most attractive: (i) finance to support the implementation of pledged policies (through a sectoral or policy-based CDM); (ii) access to low carbon technologies to enhance the effectiveness of pledged policies (both within and outside the UNFCCC); and (iii) capacity building to better assess, develop, and implement pledged policies (with possible support from ODA or GEF). Arguably more important than the type of incentive is whether access to finance, technology, or capacity building should be pegged to the quantity of the co-benefits or the quantity of GHG reduced from a policy or some combination of both. A resolution to this sticking point is to borrow an approach from China's current CDM programme that taxes CERs from projects with low developmental benefits and then supports other development-oriented projects. Along similar lines, levies from projects with low developmental benefits can be collected at the international level and allocated to countries that implement policies or projects with high developmental but low carbon benefits. Policies that fail to deliver any climate benefits would have to seek funding or support from domestic governments or from multilateral financial institutions.

While undertaking these changes, climate negotiators should also prepare for the increased monitoring and enforcement costs in the post-2012 climate regime. These costs are likely to stem from the difficulties of establishing baselines, determining leakage and double counting, and comparing ex-ante and ex-post evaluation of development benefits. As with a sectoral or policy CDM, there will also have to be appropriate actions to ensure that the influx of CERs does not lead to a dramatic drop in CER pricing. With this end in mind, these new arrangements should be piloted and phased in gradually, beginning with voluntary pledging and preliminary measurement and rewarding of co-benefits. Due to the significant untapped gains from these policies, developing countries in Asia should be particularly interested in participating in the pilot phase. Both the arrangements that recognise co-benefits and the structures that reward co-benefits should be adjusted at predetermined future times before a mandatory programme is established.

(iii) Integration across MEAs

In the long term, efforts must be intensified to identify and strengthen linkages between the co-benefits arrangements in the climate regime and other MEAs such as the CBD and the UNCCD. This institutional integration could also increase funding for policies aimed at co-benefits and facilitate the harmonisation of methods for measuring the multi-dimensional impacts of climate policies. Integration with MEAs might also prove useful for considering the co-benefits of adaptation policies, which will become increasingly relevant as the adverse impacts of climate change become more apparent in Asia.

The ultimate goal, then, would be to work towards a more and more expansive institutional framework that can systematically but simply account for the co-benefits (and co-costs) of mitigation and adaptation actions. The impetus for this framework should begin with a growing awareness of co-benefits and expansion of the co-benefit concept. Subsequently, international (and possibly domestic) arrangements and structures that recognise and reward countries for their co-benefits can be gradually scaled up. Integration across multiple regimes should demonstrate that policies that are good for the global commons are also good for local development.

4.4.2. Low carbon economy

Establishing a low carbon society (LCS) is urgent in Asia where GHG emissions are increasing rapidly due to high economic growth and increasing demand for energy. Although traditionally Asian societies adopted many low-carbon pathways of development including frugal lifestyles, current trends and projections suggest future development patterns with a large carbon footprint. It is practically impossible for developing Asia to follow the same historic growth patterns as the US, Europe and Japan, and thus there is a need to find different growth models to establish a LCS. In IGES consultations on the post-2012 climate regime, several stakeholders stressed that the design of the future regime should aim to change energy-intensive lifestyles and consumption patterns, and consider a new set of carbon standards to promote such a transition in all countries.

The core of a low-carbon economy is EE and a clean energy structure. The LCS 2050 project of the National Institute of Environmental Studies (NIES) in Japan and other similar projects suggest that the reduction of global GHG emissions by 20% by 2030 and 50-60% by 2050 or even 80% by 2100 is possible provided rapid transformation of social, industrial and economic systems takes place in the medium to long term. For example, a 70% reduction of CO₂ emissions by 2050 (compared to 1990) is feasible in Japan if a 40-45% reduction in energy demand is combined with a decarbonization of energy supply. Reductions in energy demand of 20-40% in industry (through structural changes and introduction of energy conservation technologies), 80% in passenger transport (through appropriate land use and EE improvement), 60-70% in freight transport (through controls on the distribution system and improved EE of cars), 50% in the residential sector (through high thermal insulation housing) and 40% in the commercial sector are plausible. The expected cost of introducing the enabling technologies amounts to only 1% of GDP in 2050 in Japan (NIES 2007)²⁰. The same study found that the introduction of ETS and a carbon tax would not be enough to achieve a LCS in Japan.^{21, 22}

It is important to identify which policies and measures need to be realigned to achieve a LCS in Asia. Some national models for a low carbon economy (e.g. Norway, Iceland)

are possible where hydropower or geothermal power is a major source of electricity. Iceland, for instance, intends to become the world's first hydrogen economy by 2050. To visualise similar low carbon futures in the Asian context, national energy strategies need to be based on a thorough reassessment of alternative energy potential through a comprehensive inventory of natural resource endowments. Most Asian countries, however, have not yet mapped the full potential for wind, solar, or geothermal energy sources and have only made limited efforts to exploit such sources. In this light, the recently announced "Cool Earth Promotion" initiative by the Government of Japan, which calls for the development and dissemination of 21 specific innovative technologies by around 2030, and a global goal of improving EE by 30% by 2020, can contribute greatly to the achievement of low carbon economy in Asia.

In Europe, EE gains in transport, industry and building sectors, decarbonisation of power generation through increased deployment of renewable sources, natural gas, and coal with CO₂ capture and storage, and increased use of renewable sources of energy including biofuels for transport, are some of the measures identified to move towards a low carbon pathway. Similar policies and measures need to be examined for their potential deployment in developing Asia depending on national circumstances. Reducing global emissions by 50-60% by 2050 at acceptable costs will require innovation in science and technology to make clean energy technologies more efficient and affordable. As deploying technologies such as solar, wind, biofuels, hydrogen and carbon capture and storage will be most crucial in Asia, technology development partnerships should be formed through the infusion of public funds. Stern (2007) recommended doubling the aggregate amount of public funds devoted to energy R&D to reach about \$20 billion per year.

Strategic regional cooperation, through effective investments, policies and measures to improve EE and promote RE, will play a key role in establishing a LCS in Asia. To encourage a shift in the direction of EE and RE sources, greater attention should be directed to bilateral and multilateral development assistance. The role of developed countries such as Japan and other G8 economies and multilateral financial institutions such as the World Bank is crucial to accelerating the transition to a low carbon economy. Leveraging such investments with private resources is also essential.

Developing Asia receives substantial bilateral assistance for energy, with 14 Asian countries among the top 20 recipients of bilateral development assistance for energy. Japan, which has provided a large portion of annual energy assistance of about \$6-7 billion for the past 7 years, is well placed to provide leadership by mainstreaming EE and RE projects in its development assistance portfolios. Likewise, ADB could double annual investments in its Energy Efficiency Initiative from the current level of \$1 billion. A recent proposal by Japan, the USA and the EU to create a new body to promote energy conservation measures within the International Energy Agency (IEA), and Japan's announcement to invest about \$30 billion over the next 5 years in R&D in the energy and environment sectors will also be useful.

Addressing climate change in the next 25 years will require significant changes in the patterns of investment and financial flows. Assuming emissions reduction by industrialised countries will be on the order of 60-80% of their 1990 emissions by mid-century, half of which are anticipated to be met through investment in developing countries, emission reduction purchases of up to \$100 billion per year can be estimated (UNFCCC 2007). The infrastructure component of current ODA amounts to only 0.2%

of total investment, reaching 22% if FDI is included (UNFCCC 2007). Current ODA levels for infrastructure will not be enough to develop the infrastructure necessary for a LCS. Therefore private sector funds will be crucial in the long-term. IEA estimates that as much as \$20 trillion would be required for global energy investment by 2030, of which \$10 trillion is expected to flow to China, India and Brazil.

Only low carbon supply options are compatible with a carbon-constrained world. Several solutions to create a LCS are within Asia's reach. Policymakers and politicians will need to show leadership by moderating the growth of GHG emissions in the near term and putting in place a comprehensive plan of action for changing the emissions trajectory by 2012.

5. Conclusions

The science and economics of climate change have advanced considerably since the establishment of the IPCC in 1988. Likewise, the global discussions on climate change have moved forward significantly since the adoption of the UNFCCC in 1992. However, progress in aligning climate actions with sustainable developmental strategies has been slow and inadequate at the global level and particularly in Asia. It is now widely understood that climate policy alone will not solve the climate change problem. Climate outcomes are influenced not only by climate-specific policies but also by the mix of development choices made and the development paths along which these policies move forward (IPCC 2007). Therefore, the most promising route to stabilizing emissions from the region will involve formulating and implementing climate-friendly developmental policies.

As climate change is set to reverse decades of social and economic development across Asia, there is no other region that would benefit more from the alignment of climate and development actions. The additional costs incurred in such alignment, if any, must be viewed as an insurance policy against the potentially severe consequences of unchecked GHG emissions in the region. The time for action is now and countries in Asia need to make the right choices for sustainable development—particularly development that enhances the adaptive capacity of Asian populations and development with minimal growth in GHG emissions. The choices range from more effective participation in the future climate regime to developing a decarbonised society based on a new energy paradigm.

Beyond the four priorities discussed above to realise the vision of a low-carbon climate-resilient Asia, two additional characteristics should be evident in Asia's future climate policies. First, climate policies should retain the flexibility needed to accommodate the continually evolving nature of climate change. Second, policies should be firm enough to withstand opposition from vested industrial interests. In this connection, it is important to mobilise constituencies that are significantly sensitive to climate change (e.g. forestry, agriculture, fisheries, water) to offset the interests of other industries. Striking a balance between flexibility and firmness—crafting a resilient climate policy—will be a challenge, but it can be addressed with strong political will and concerted action at multiple levels. It will require additional research on new mechanisms that enable the switch from dirty to sustainable development, and on ways to realise a sustainable development paradigm that fully integrates climate concerns. Perhaps more consideration should be given to

enhancing the role of the financial and investment agencies to favour climate-friendly development. Further research on climate change insurance (especially the assessment and actual implementation of insurance products in developing Asia), and low carbon technologies and technology policies relevant to natural resource endowments in Asia is also necessary. Enhancement of research capacity for integrated assessment modelling of impacts and for determining the costs of climate action and inaction at the national and local levels is also crucial.

While the current development patterns in Asia have thus far emulated unsustainable patterns in developed countries, the region does not have to (and cannot) continue along this same trajectory. Since much of Asia's energy and material infrastructure will be built in the near future, regional policymakers should pursue an alternative low carbon developmental path. In China's building sector, to cite an area where such potential exists, approximately half of the building stock will be constructed over the next 15 years. When estimates like these are projected across multiple sectors and countries the implication is clear: not only will it be imprudent for Asia to follow the same development path as industrialised countries, but there are opportunities for leapfrogging to a lower carbon developmental trajectory if an appropriate mix of policies is adopted and implemented.

A step toward capitalising on this opportunity would be the establishment of medium and long-term developmental goals and targets which integrate climate change goals and targets for the next 20 to 50 years. Recent events seem to point in this direction. Japan, for instance, proposed a global target of halving GHG emissions by the year 2050. China released its National Climate Change Action Plan, which reiterates previously made pledges to improve energy intensity, expand the use of RE, and increase forest coverage, although it does not commit to specific long term emission targets. India plans to release a similar national plan in 2008. There are growing indications that countries in Asia are prepared to take a proactive stance in global climate negotiations. Asia is poised to take the lead in shaping a new world developmental order that duly reflects the challenges presented by climate change.

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Endnotes – Chapter 2

¹ The proportion of Asians who live in urban areas has increased from 30% in 1990 to 38% today, and is projected to rise to 50% by 2030.

² Large scale expansion of household electricity access is underway in many countries, most notably in India, the Philippines, Bangladesh and Sri Lanka. In 2005, India, which accounts for nearly one third of the 1.6 billion people worldwide without electricity, is reported to have connected 4 million households. Rural electricity access in Vietnam is reported to have increased from 51% in 1996 to 88% in 2004. Overall energy demand for the Asia and Pacific region is expected to more than double from 1997 to 2020. All these changes are accompanied by increased GHG emissions.

³ More than 70% of Asia's energy comes from fossil fuels, the majority of which is coal-based.

⁴ As rising temperatures cause glaciers to melt, the accumulation of water places strains on moraines (ice dams) and increases the likelihood that they will be breached. Glacial lake outburst floods have increased in frequency in the Himalayas in the latter half of the 20th century. See Germanwatch, *Glacial Lake Outburst Floods in Nepal and Switzerland: Glacial Lake Outburst Floods*, 2004, <http://www.germanwatch.org/download/klak/fb-gl-e.pdf>.

⁵ Wetlands International estimates that Southeast Asia's peat lands store 42,000 million tonnes of carbon.

⁶ For low income countries, natural disasters can cost an average of 5% of GDP.

⁷ Sea levels are projected to rise from 3 to 16 cm by 2030, and from 7 to 50 cm by 2070. The estimates do not account for potential contributions from melt of the ice sheets of West Antarctica or Greenland, which could contribute to sea-level rise of approximately 5 and 7 metres, and intensified storm surges.

⁸ These figures capture costs that are not captured in the Stern model mean level estimates, such as (i) disproportionate impacts on poor and vulnerable communities; (ii) unpredictable and extreme non-linear events (weather and natural resource crises); and (iii) continued emission increases that raise temperatures (and heighten the risks of mass migration).

⁹ The data for this category—"estimates that do not reflect the full range of costs"—is only reported for India, Southeast Asia, and Africa. To arrive at estimates for only India and Southeast Asia, the proportion of the people from India and Southeast Asia from the full range of costs category ($100/145=0.68$) is multiplied by the reported "not reflecting the full range of costs" figure for India, Southeast Asia, and Africa (35 million). $35 \text{ million} \times 0.68=24 \text{ million}$.

¹⁰ These estimates reflect what would occur if there are amplifying feedbacks in the climate system.

¹¹ The data for this category—"estimates that do not reflect the full range of costs"—is only reported for India, Southeast Asia, and Africa. To arrive at estimates for only India and Southeast Asia, the proportion of the people from India and Southeast Asia from the full range of costs category ($150/220=0.68$) is multiplied by the reported "not reflecting the full range of costs" figure for India, Southeast Asia, and Africa (50 million). $50 \text{ million} \times 0.68=34 \text{ million}$.

¹² "No regret" options are steps to reduce GHGs that would pay for themselves even without a climate change policy (Pew Centre). "Win-win" measures are options that are advantageous or satisfactory to all parties involved (Webster).

¹³ The plan includes targets for wind (30 GW), solar power PV (1.8 GW), biomass power (30 GW) and small hydro (80 GW).

¹⁴ Decisions adopted by the Nineteenth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer (Advance, untitled edition), 2007.

http://ozone.unep.org/Meeting_Documents/mop/19mop/MOP_19_ReportE.pdf

¹⁵ This shortcoming is also partly related to the lack of emphasis on the role of private sector in coping with the impacts of climate change. In contrast, the role of the private sector in mitigation was more evident.

¹⁶ <http://ocwr.ouce.ox.ac.uk/research/wmpg/cvi>

¹⁷ <http://maindb.unfccc.int/public/adaptation/> The database on local coping strategies at the UNFCCC is intended to facilitate the transfer of long-standing coping strategies/mechanisms, knowledge and experience from communities that have had to adapt to specific hazards or climatic conditions to communities that may just be starting to experience such conditions as a result of climate change.

¹⁸ Ellis offers a more complete classification scheme, noting that co-benefits can be direct and indirect; can be company-specific, local, regional, national, and global; and they can flow to project developers or local governments. (Ellis 2007).

¹⁹ Similar figures are cited from other studies in Asia. A study using data from Shanghai shows that health loss arising from air pollution was equal to 1.6% of GDP in 2000 (Kan et al. 2004).

²⁰ NIES "Japan Low Carbon Society" scenario team. 2007. Japan Scenarios towards Low-Carbon Society (LCS)-Feasibility study for 70% CO₂ emission reduction by 2050 below 1990 level. February 2007. http://2050.nies.go.jp/interimreport/20070215_report_e.pdf

²¹ IGES International Symposium: Climate Change and Business Strategy in Europe: Short-term Profit or Long-term Investment? (Japanese) http://www.iges.or.jp/jp/news/event/0704cp_sympto/index.html

²² Japan Low Carbon Society Scenarios Toward 2050-International Symposium: The Challenge of Reforming Industrial Structure Aiming for Low Carbon Society. 18 October 2007. Tokyo, Japan. http://www.iges.or.jp/2050/index_e.html

PART II

| CHAPTER 3 |

MITIGATION AND ADAPTATION – SECTORS AND ACTORS



Chapter 3

Mitigation and Adaptation – Sectors and Actors

Introduction

Focussing upon climate change related issues within selected sectors or topics, this chapter summarises how Part II of the White Paper addresses the impacts of climate change on key sectors and policy responses from around the Asia-Pacific region. Four priorities were identified in Chapter 2 for consideration by the region's policymakers: (i) achieving global participation in the future climate regime through more effective involvement of developing countries in the Asia-Pacific; (ii) enhancing the adaptive capacity of the region's vulnerable populations; (iii) seeking the best use of the power of market mechanisms (predominantly for mitigation); and (iv) realising the vision of a sustainably developed but low carbon society through effective design of policies with joint climate and sustainable developmental benefits. These four priorities are being explored in much greater depth through a series of ongoing research projects being undertaken by the Institute for Global Environmental Strategies (IGES). Broadly, Part II of the White Paper outlines four sectoral studies and two studies of the key actors, drawing from IGES' ongoing strategic research. Some of the key questions addressed in Part II are as follows.

What is the current status of climate change aspects of sectoral policies in the region?

Most of the current sectoral policies in the region have yet to recognise, let alone adequately deal with, the impacts of climate change. There are a few pilot projects where mitigation and adaptation to climate change are being promoted by the multilateral development banks and there is an emerging financial mechanism for such projects through the Global Environment Facility (GEF). Where clean development mechanism (CDM) projects are available, sectoral agencies in developing countries have taken advantage of a new funding mechanism for projects.

However, most sectoral agencies have not yet formed an adequate understanding of how their own sector will be impacted by climate change (a subject that is dealt with in greater detail in subsequent chapters of the White Paper) or how their sector may have climate change impacts on other sectors. They understand in broad terms that average temperatures may rise, extreme climate events may become more frequent, sea level may rise, glaciers are likely to melt faster, etc., but this general knowledge has rarely been translated into specific changes, specific locations and specific time frames that would indicate when and where a specific kind of policy response will be needed. Hence, most sectoral agencies and sector policymakers have taken a "wait and see" attitude.

As the climate is likely to change over a long period of time, the impacts may not be obvious or serious for several decades, and while mainstream mass media maintain that there is still considerable uncertainty regarding climate change, policymakers are reluctant to act hastily. They may be more convinced by “no regrets” strategies that achieve climate change control goals while simultaneously meeting other sectoral goals, at minimal or no additional cost. However, they are not yet ready to implement transformative policies that would attack directly the underlying production and consumption drivers.

In Chapters 4, 5, and 6, the White Paper examines sectoral policy responses to climate change mitigation in three key sectors—forestry, energy and waste management. By way of contrast, Chapter 7 focuses on another sector, water, where adaptation is likely to be crucial under the conditions projected for the latter part of this century.

It is clear that current climate change policies in Asia-Pacific are not adequate, in virtually all sectors. Much deeper cuts in greenhouse (GHG) emissions will be needed to keep atmospheric levels to historic norms. Much faster and more comprehensive adaptation measures will be needed in low-lying countries in danger from sea level rise, continental countries dependent on glacial melt to support agricultural production, and countries already suffering from accelerated desertification. The national commitments to global agreements on climate change are taken seriously in too few countries in the region. Sectoral policies to address climate change, where they exist, are not being implemented rigorously as most countries believe there is still plenty of time to watch the impending climate changes unfold. In some cold countries, decision-makers may even believe that they will be better off with a warmer climate, so see no need to take precipitous action.

What are the priorities for national and regional policymakers to move from environmental policy as mere rhetoric to robust transformation of production and consumption sectors?

To bring climate change to the fore of policymaking, any lingering uncertainty driven by the oil and coal industry and supported by parts of the mass media needs to be systematically answered. The Intergovernmental Panel on Climate Change (IPCC) and Al Gore’s movie (*An Inconvenient Truth*) have gone a long way in raising public awareness of climate change issues and the need for policy change. Thanks to such efforts, in most countries, an increasing number of policymakers are now fully aware of climate change and the associated potential risks. However, there are still some who remain skeptical of climate change.

Once there is adequate acceptance that climate change is real and is caused by human action, the next greatest need in the developing countries of Asia and the Pacific is to find policy solutions that simultaneously address poverty alleviation and climate change. In the region’s developed countries, the policy challenge is to continuously and drastically decouple energy use and economic growth, without transferring energy intensive (and polluting) industries to developing countries. In all countries, policies that hasten technology change and improved energy efficiency must continue. In almost no country has there been an effective set of policies to reduce energy intensive consumption. This may prove to be the greatest challenge of all, as people in all developing countries hope to emulate the consumption luxuries of the USA and Europe.

How are developing countries approaching mitigation in key sectors?

Most developing countries in Asia and the Pacific find it rather unfair to be asked to contribute to reduction of GHG emissions, especially when their per capita emissions are so much lower than developed countries. Now we live in a globalising world, in which developed and developing countries are intrinsically linked. A significant portion of the production from developing countries is consumed in developed countries, and large volumes of e-waste, for example, are transferred to developing countries for extraction of valuable embedded materials. Indeed, globalisation of industry makes it more difficult to know where ultimate responsibilities for GHG emissions lie. There is always willingness, however, for developing countries as part of a globalised economy to contribute to global mitigation efforts under specific conditions that meet their national economic and social welfare interests.

For example, countries that are interested in maintaining or expanding national forest cover need to find a good economic argument to keep valuable resources “locked up” or to prevent landless farmers and illegal loggers from abrogating state ownership and control of the forest resources. If wealthy developed countries are prepared to pay for carbon sequestration in the forest domain of developing countries, then this can be a win-win situation. The international community is now attempting to extend this win-win logic to “reduced emissions from deforestation and degradation in developing countries” (REDD). As it is not in the interests of the global community to have countries continuously releasing the second largest source of GHG emissions through deforestation, then perhaps developed countries could also pay for the climate benefits of avoided deforestation. This approach would have the added benefits of preserving biodiversity in tropical forests and maintaining critical ecosystem functions, such as protection of watersheds, although there are some technical issues to resolve first. How would such arrangements impinge on forest dependent communities, often with inadequate tenure rights over their traditional forest areas? Would payment for carbon sequestration in the tropical forests of Asia-Pacific assist or detract from sustainable development? Would the inclusion of REDD in global carbon trading schemes have adverse impacts on the price of carbon or should there be a separate market? These and other related aspects of the complex world of climate change and forest policy in the Asia-Pacific are addressed in Chapter 4.

A remarkably similar set of policy calculations are implied in Chapter 5, dealing with the controversial issue of biofuels. Here the interests of developing countries lie in creating a new export product and/or enabling a degree of national energy security. From an economic perspective, countries with abundant land, water and sunlight, plus cheap labour should have a comparative advantage in producing biofuel crops for a rapidly growing global market. Mandatory requirements to achieve certain levels of biofuel use as part of developed country responses to climate change have helped to create a sizable market opening for biodiesel and bioethanol production in developing countries.

In the rush to develop biofuel crops (like oil palm and sugar cane), the impacts of biofuel production on sustainable rural development and food prices are beginning to become clearer. If agricultural land is devoted to biofuel crops, then the opportunity cost of land becomes tied to global energy policy and pricing and is divorced from its critical role in food production and food security. It is also possible that excessive development of biofuel crops may lead to renewed pressure for deforestation, paradoxically linking these two responses to climate change mitigation in a conflicting

manner. Oil palm plantations on converted tropical peat land may actually increase GHG emissions rather than contribute to climate change mitigation.

Chapter 5 indicates that a preferred course of development for biofuel production would be to focus on waste as raw material, rather than occupying valuable land needed for food production or destroying tropical forests. For example, if cost-effective second generation biofuel technologies are developed, wasteland (like the large areas of along along grassland in Asia) could be used for production of cellulosic ethanol, or municipal solid wastes could be used to produce compressed natural gas from controlled landfills. Combining waste recycling and biofuels production is another means of integrating sustainable development and climate change. Further technological development and economies of scale may be needed, however, before the waste-to-biofuel route is a viable policy option.

Chapter 6 provides a further link to the role of wastes in mitigating climate change, but from a slightly different perspective. It focuses on the linkages between municipal organic waste management and climate change in developing nations of the Asia-Pacific. The current practice of dumping unsorted municipal waste in landfill sites is not a sustainable solution in the long term. Organic wastes in traditional landfills normally degrade under partly anaerobic conditions and generate methane emissions. Methane is a more potent GHG than carbon dioxide (CO₂) and is a major contributor to climate change. Collecting and using landfill gas, composting and biogas production from organic wastes are examined as possible ways of minimising this GHG. A life cycle analysis approach is adopted to narrow down the most appropriate policy responses to deal with methane emissions from municipal waste. Extracting energy (and raw materials) from waste is consistent with the “reduce, reuse, recycle” (3R) approach being adopted as part of sustainable development strategies and is further evidence of how the climate change and sustainable development can be integrated.

What about adaptation?

As many developing countries in the Asia-Pacific are relatively minor contributors to global warming, but all countries are likely to be affected by the consequences of global climate change, their primary interest is often directed towards adaptation rather than mitigation. The need for adaptation has a high level of awareness especially in Pacific Island countries, but is gradually receiving greater attention in other low-lying areas as well. Any comprehensive plan to address climate change will need to pay equal attention to mitigation and adaptation. Virtually all sectors will need to have adaptation plans.

As climate change will have major impacts on the region's freshwater resources, ranging from increased floods to increased incidence of droughts, depending on location and season, this topic has been chosen for analysis in Chapter 7. Much of the Asia-Pacific region relies on groundwater as a major source and store of freshwater. Unfortunately, existing pressures on this resource have led to overexploitation and serious pollution of groundwater, particularly in densely populated urban areas. Chapter 7 examines whether climate change will make this existing situation better or worse, and where it is made worse, what adaptation measures might be proposed. The difference between “no-regrets” adaptation measures and more anticipatory measures that might result in needless expenditure and their respective levels of benefit is

documented. As in the other chapters in Part II, this chapter also highlights why climate change adaptation is an integral part of sustainable development planning.

How are the key actors responding to the climate change challenges?

The first institutional reality to face is that everyone is in this climate change mess together, as the atmosphere is a clear example of a global commons, meaning that a wide range of partnerships across all countries is needed. No single group will be able to tackle all of the dimensions of climate change on its own. Public-private partnerships may help in seeking changes in industrial production, energy and transportation systems. Consumers need to be encouraged to make lifestyle changes that will reduce pressure on the global climate, but such encouragement may come in the form of public policies that will often be unwelcome. Sectoral agencies need to cooperate under executive leadership. Above all, courageous political leadership is needed to fend off the pressure from vested interests and to take resolute action even when uncertainty lingers.

Chapters 8 and 9 analyse the key actors in the climate change scenario playing out in the Asia-Pacific region. The first observation reinforces the recommendation of Part I that global participation in the future climate regime is crucial and countries in the Asia-Pacific region should take a more proactive role in future negotiations. While each country tends to view climate change from different angles, all countries will be affected to some extent and, therefore, all countries need to participate in finding solutions. This means that not only all countries need to be given space to express their differing perspectives, but also that all interest groups within each country must feel that they have been given adequate opportunity to participate.

Chapter 8 explores how governments in the Asia-Pacific region have responded to the challenges of climate change since ratifying the UNFCCC. What institutions have been created, what legislation has been enacted, and what policies have been adopted? This chapter identifies the most promising and/or effective institutional options. If institutions matter, as demonstrated in earlier chapters, then Chapter 8 lays out the existing institutional foundation for future climate change regimes and identifies the emerging institutional challenges, as the region comes under increasing global pressure to take a more proactive role in mitigating the impacts of climate change. Chapter 8 demonstrates that there is a danger that the separate focus on climate change and sustainable development in the Asia-Pacific region will become institutionalised, as difficulties in cross-ministry communication is a common feature of government administrations in developing countries. Chapter 8 examines global best practices for a more integrated approach to environmental governance.

Chapter 8 also looks at how the principle of subsidiarity is employed in the region and how this may affect decentralised institutional arrangements for dealing with climate change. There is considerable evidence from developed countries that sub-national and municipal governments often have more active and practical environmental programmes than the central government. This has spilled over into the area of climate change, especially in those governments which tend to adopt a “wait and see” attitude. The relationship between the different layers of administration and how clear roles regarding mitigation and adaptation can be defined is examined from the perspective of governments with differing views on how to deal with climate change.

Chapter 9 addresses the issue of energy efficiency (EE) solutions from the perspective of the industrial sector. Business responsibilities in this region have expanded gradually from profit-making to multiple responsibilities including clean air and corporate environmental and social responsibility (CESR). CESR encompasses business responses to climate change, ranging from EE audits to carbon neutrality.

As the debate on climate change has been elevated in international policy regimes, all stakeholders are now looking to businesses as solution-providers for mitigation and adaptation strategies. Business appears to be increasingly aware of its responsibility, but operates in an environment of high complexity and uncertainty. Chapter 9 discusses the role of business in improving EE in the industrial sector, as industries are responsible for a significant portion of emissions and must factor climate change responses into future technology choices and investment. By illustrating business cases of short payback periods and increased profits, the chapter shows that EE can be a no-regrets strategy or “low hanging fruit” for companies of all sizes.

As shown in Part I of the White Paper, acceptance of new ways to address climate change depends on a shift in the perceived benefits of making those changes by a critical mass of affected stakeholders. Chapter 9 analyses the constraints faced by industries to invest in EE, and examines corrective actions to be taken by policymakers and other stakeholders.

| CHAPTER 4 |

REDUCED EMISSIONS FROM DEFORESTATION AND FOREST DEGRADATION IN DEVELOPING COUNTRIES: RISKS AND OPPORTUNITIES FOR RURAL COMMUNITIES IN THE ASIA-PACIFIC REGION



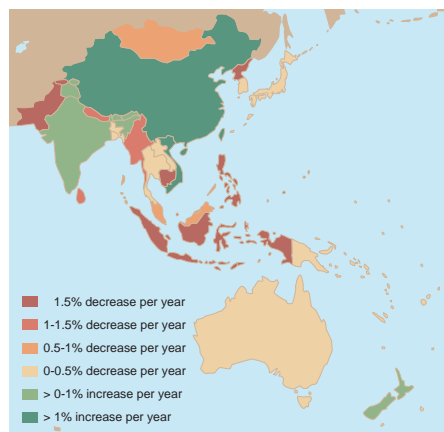
Chapter 4

Reduced Emissions from Deforestation and Forest Degradation in Developing Countries: Risks and Opportunities for Rural Communities in the Asia-Pacific Region

1. Introduction

Forests fulfil economic, social and environmental functions from local to global levels that are critical to human survival and wellbeing. Amongst these, international attention to the role of forests and their soils as sinks and reservoirs of greenhouse gases (GHG) is increasing due to growing concern over climate change. Global forest loss has continued into this decade at slowing but still alarming rates. The Food and Agriculture Organisation of the United Nations (FAO) estimated that the annual rate of global deforestation from 2000–2005 was 13 million hectares (ha) (FAO 2006a). Despite some uncertainty about this figure (Ramankutty et al. 2007; Grainger 2008), high rates of deforestation in tropical countries continue to be recorded. The National Institute for Space Research of Brazil recently reported that deforestation in the Amazon has accelerated; 6,000 square kilometres (km²) of rainforest were lost in the last four months of 2007, and the rate is expected to increase in 2008 (NZ Herald 2008). Asia-Pacific countries continue to experience rates of forest loss that are amongst the world's highest, in some instances exceeding 1.5%/year (fig. 4.1).

Figure 4.1. Rates of forest change (2000-2005)



Source: FAO (2007).

Forest degradation is expected to accelerate as the effects of climate change are felt. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report warns that the negative effects on forests may be larger than projected and that the positive impacts have been overestimated (IPCC 2007). Tropical forests in eastern Amazonia are projected to be succeeded by savanna and boreal forests are likely to be especially affected by climate change. Increased risk of wildfire, pest outbreaks and accelerated deforestation driven by reduced land productivity under altered climate conditions are projected for some regions.

Emissions from deforestation during the 1990s are estimated at 5.8 gigatonnes of carbon dioxide equivalent per year ($\text{GtCO}_2\text{eq/yr}$) (IPCC 2007). In 2004, emissions from deforestation were responsible for about 7–16% of total GHG emissions (not including ozone-depleting substances) (Rogner et al. 2007), making deforestation the second largest anthropogenic source of CO_2 after fossil fuel combustion.¹ Forests store more carbon in their biomass, dead wood, litter and soil than the carbon that exists in the atmosphere (FAO 2006a) and tropical deforestation alone could release between 87 and 130 billion t of carbon by the end of the century, which is equivalent to the emissions from a decade of fossil fuel consumption at current rates (Gullison et al. 2007).

The current enthusiasm for biofuels as a more climate friendly alternative to fossil fuels could have the perverse effect of further increasing GHG emissions from deforestation in the rush to establish biofuel plantations and crops (see chapter 5). In Indonesia, demand for biodiesel by 2025 will require 1.4 million ha of oil palm plantations (DFID/World Bank 2007). More than a quarter of Indonesia's oil palm concessions are on peat land, where it is estimated that the production of one t of palm oil causes an average emission of 20 t of carbon from peat decomposition alone (Wetlands International 2006).

The concept of providing a financial incentive for forest conservation through international financial transfers connected with carbon, or reduced emissions from deforestation and forest degradation in developing countries (REDD), is now high on the international climate agenda. REDD would bring a new set of actors with fresh resources and present risks as well as opportunities for forest management. The risks are to governance, rural livelihoods and the integrity of the Kyoto Protocol. Much of the debate within the United Nations Framework Convention on Climate Change (UNFCCC) on REDD and the content of a growing number of REDD proposals from governments and others has focused on technical and methodological issues, and financial transfers. Less attention has been paid to deforestation as a manifestation of governance failure. This failure of governance largely explains why past international transfers of funds and a variety of initiatives and processes from the local to international level to conserve forests have had little discernable impact on rates of deforestation (Robledo and Masera 2007).

The objective of this chapter is to clarify the risks and opportunities for rural communities of national REDD systems and project-level REDD. The basic hypothesis is that if REDD is designed with a narrow focus on climate change, it could harm the welfare of forest-dependent communities, reward continued poor governance and elites that control forest resources, and do little to alleviate rural poverty.

The chapter begins by exploring the logic behind REDD, and then discusses its implications for forest governance, tenure and livelihood concerns. The discussion then turns to the treatment of forests under the UNFCCC and touches upon the main issues confronting climate change negotiators. The capacity of communities to participate in REDD is assessed along with the benefits their participation might offer. Finally the role of independent standards in ensuring positive development outcomes of REDD is discussed and the chapter concludes by extracting several broad policy messages and identifying areas requiring further research.

2. REDD logic

Forests play an important role in mitigating climate change. Forestry offers REDD, afforestation, increasing sequestration in existing forests, biomass for bio-energy and wood as a substitute for more energy intensive products such as concrete, aluminium, steel and plastics, as potential climate mitigation options.

As one of these potential mitigation options, REDD could include both deforestation and forest degradation. The UNFCCC defines deforestation as “the direct human-induced conversion of forested land to non-forested land” (UNFCCC 2002) and provides quantitative criteria, including tree height, minimum area and percentage of crown cover, for national forest definitions. In contrast, forest degradation does not result in land-use change and has not been defined by the UNFCCC. The IPCC has proposed some options for definitions and methodologies, specifically to inventory emissions from direct human-induced degradation of forests (see Penman et al. 2003). The proposed definitions include (i) a reduction in the overall potential of forests to provide benefits, (ii) a reduction in forest-carbon stocks and (iii) a long-term reduction in biomass density (Penman et al. 2003; Robledo and Masera 2007, 29).

REDD rests on the logic of an “avoided bad”, whereas climate mitigation activities currently recognised under the clean development mechanism (CDM) of the Kyoto Protocol rest on the logic of a “committed good” (box 4.1.). A fundamental weakness of this basic logic is that the same claim of an avoided bad could be made for many other activities. For example, poor countries could claim that their lower consumption (compared to developed countries) has resulted in lowered GHG emissions and even population control programmes could be claimed as leading to avoided emissions through fewer births.

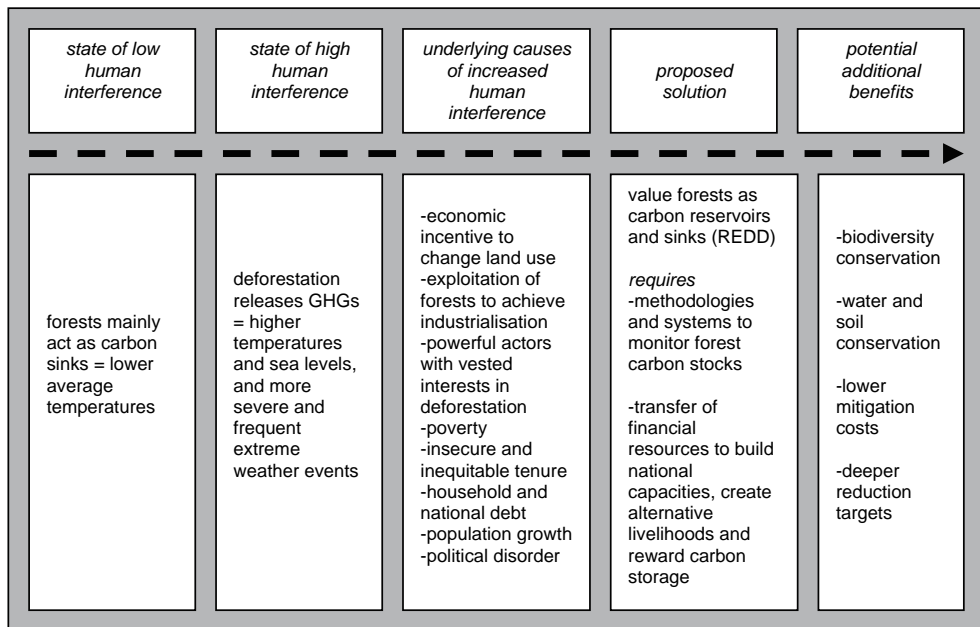
Despite the weakness of the logic of emissions avoidance, the reality that deforestation is a major source of GHG emissions cannot be ignored. Moreover, despite the risks that REDD poses and the significant technical, methodological and policy challenges that must be met, REDD has strong support and appears likely to become a reality in one form or another.

Putting to one side the basic logic, the observations and assertions for supporting REDD include:

(i) Deforestation is the second largest source of anthropogenic CO₂ emissions after fossil fuel combustion (Rogner et al. 2007);

- (ii) Reducing deforestation rates by half by 2050 and maintaining them thereafter would contribute up to 12% of the total emission reductions required to stabilise atmospheric CO₂ levels at 450 parts per million (ppm) through 2100 (Gullison et al. 2007);
- (iii) REDD is a relatively low cost mitigation option that would lower the economic costs of achieving global emissions reductions and is thus a “highly cost-effective way to reduce emissions” (Stern 2006);
- (iv) The carbon mitigation benefits of REDD over the short term exceed the benefits from afforestation and reforestation (A/R) (IPCC 2007); and
- (v) REDD could encourage deeper emissions targets to achieve the UNFCCC’s objective of “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (UNFCCC 1992).

Box 4.1. REDD logic



3. Understanding deforestation: Governance, tenure and livelihoods

Although the logic underlying REDD is attractive for its simplicity, it does not pay enough attention to the political roots of deforestation, which could lead to undesirable outcomes. The underlying causes of deforestation, as described in the previous IGES white paper (IGES 2005), include (i) the failure of markets to reflect the full value of forest functions; (ii) national policies to exploit forests to promote rural development and industrialisation without adequate environmental safeguards; (iii) the actions of business, military and other elites to extract forest resources above sustainable levels and to convert land to other uses; (iv) poverty and population growth; (v) political disorder associated with conflict and sudden transitions in national administration; and (vi) insecure and inequitable tenure.

Deforestation is mostly a social and governance failure, rather than an environmental failure (i.e. a lack of knowledge on how to manage the environment). Unless REDD tackles the causes, as has been experienced with many other forest management initiatives and policy instruments, it will produce few tangible results. Treating REDD as a simple and cheap form of GHG emission reduction illustrates the danger of climate change being divorced from sustainable development. The basic premise of this chapter is that to achieve combined climate change mitigation and sustainable development objectives, REDD must promote:

- Accountable and transparent forest governance;
- Secure and equitable forest tenure; and
- Sustainable livelihoods.

The difficulty of this task should not be underestimated, as Boxes 4.2. and 4.3. illustrate, and the history of failure must be understood and addressed.

Box 4.2. Potential opportunities and risks of REDD in Papua New Guinea (PNG)

Forest resource

- World's third largest cover of tropical rainforest; about 73% of total land area covered by forest or other wooded land (FAO 2006a).
- "Enormous" ecological value: flora comprises more than 11,000 species and lowland forests contain about 2,000 timber species (FAO 2000).
- Forestry industry accounted for 3 - 5% of GDP since 1999 (DFAT 2004).
- Important economic and cultural significance for communities that have constructed their livelihood systems, social institutions and rituals around forests.

Forest allocation

- About 25% of forests have production as their primary function (FAO 2006a).
- Only 0.5 million ha under protection; its delineation, management authority, monitoring and enforcement are ambiguous and uncertain (ITTO 2007).
- Only 92,000 ha of forest plantations have been established (FAO 2006a).

Governance, tenure and livelihoods

- 97% of the land is held under systems of customary tenure, involving clans or kinship groups; these systems are acknowledged by the Constitution.
- Government must negotiate with resource owners before it can undertake a forest development project.
- Legally, resource owners are in a very powerful position, but in reality their position is often weak because of a "lack of pre-informed consent and failure to follow formal procedures" (ITTO 2007) when the PNG Forestry Authority acquires timber rights from them.
- PNG has "the necessary policies, laws, regulations and guidelines required to ensure that sustainable timber production can be achieved" (2003/2004 Review Team) but implementation of the Forest Law is weak.
- Major problems in the logging industry are (i) non-compliance with laws in all aspects of forest acquisition, forest allocation, and forest operations, and (ii) non-compliance with timber permit conditions (Bun and Scheyvens 2007).
- Government has strongly defended industrial-scale logging of natural forests under concessions and has sought to accelerate the granting of timber permits.

Deforestation and forest degradation

- Annual deforestation between 1990 and 2005 was estimated at about 0.4% (FAO 2006), though higher rates are estimated by some nongovernmental organisations (NGO) (ITTO 2007).
- Deforestation is due largely to conversion for agriculture. Forests are felled and burnt by the traditional resource owners to establish gardens for subsistence and are under increasing pressure from a population that swells by 2.7% each year (AusAID 2007).
- Developers disturb forests through mining, oil and gas exploration, and land conversion, particularly to plant oil palm.
- Most international concern has been directed towards the management of natural production forests by concessionaires.

Opportunities (✓) and risks (✗) of REDD for sustainable forest management

- ✓ REDD could provide much needed resources to the PNG Forestry Authority to fulfil its responsibilities in the acquisition of timber rights, to ensure compliance from loggers with regulations governing forest harvesting, and to ensure that timber permit holders uphold their contractual obligations. Additional resources could enable the Forestry Authority to avoid undue interference of logging companies and politicians in the conduct of its operations.
- ✓ REDD could provide an additional financial incentive for resource owners to manage their forests, as an alternative to handing over timber rights, through the government, to logging companies. The certification of community-based forest management in PNG against tough international standards is evidence that the traditional resource owners can implement “modern” systems of forest management involving inventories, land use planning, and monitoring (Bun and Scheyvens 2007).
- ✗ Additional resources provided under REDD could further entrench industrial-scale logging concessions as the dominant regime for natural production forest management.
- ✗ The process by which the state acquires rights for forests to be conserved as carbon stocks under REDD could marginalise resource owners from the management of their forests.
- ✗ The state could use the additional resources provided by REDD to equip itself to respond to any resistance to REDD projects with undue force.

Improved governance is particularly relevant for forests as they are often highly contested resources because of their economic value, their potential to influence political fortunes, their private and public benefits and because of contending stakeholder views of how they should be managed and who has the right to participate in decision-making. A feature of forest governance in the Asia-Pacific region is that governments claim ownership of most forests and have centralised forest administration under specialised authorities, with a few exceptions. A FAO study of forest tenure in 17 countries in Southeast Asia found that over 90% of forests are publicly owned (FAO 2006b), which, particularly in forest-rich countries, places the state in a powerful position as the assigner of exclusive forest rights.

Governments have retained exclusive rights over some forests and have allocated rights for other forests to private companies, collectives, communities, and individual households. The fate of state-owned natural forests lies in how forest rights are assigned, who they are assigned to, the content of these rights, their attendant obligations, and their limits. These issues are captured by the broad concept of forest

tenure, which includes ownership, tenancy and other arrangement for the use of forests, and determines rights to use resources, their recipients, their duration and the conditions under which they exist.

Forest management in the Asia-Pacific region has been troubled by weak systems of governance, which have created insecure and inequitable forest tenure arrangements. In turn, these arrangements have, *inter alia*, criminalised and undermined traditional livelihood activities of forest-dependent people², without providing alternatives, thereby increasing their vulnerability and contributing to poverty. The consequences of inadequate attention of forest policy to equitable and secure tenure and livelihoods are particularly apparent for forests allocated as industrial concessions or set aside as protected areas.

3.1. Industrial concession forests

Amongst the ten International Tropical Timber Organisation (ITTO) Asia-Pacific producer member countries, 71% of forests are allocated to concessions or are under some form of licence (ITTO 2006, 50). Nearly all concessions in the region are at least nominally managed using selective silvicultural systems with the intention of keeping the land under permanent forest cover. Selective cutting is meant to remove biomass equivalent to the mean annual increment, but the ITTO estimates that only 15% of production forest is managed in a sustainable manner (ITTO 2006).

Although the discourse of REDD has largely concentrated on protection forests, the largest sustained mitigation benefit from forestry would be generated by maintaining or increasing carbon stocks in forests that are managed to provide a sustainable supply of timber, fibre or energy (Nabuurs et al. 2007). In principle, REDD could be applied to natural production forests to provide forestry authorities with much needed resources to evaluate and monitor forestry operations. Reduced impact logging techniques and silvicultural prescriptions such as strip planting could also be used to maintain carbon stocks.

However, a prior and more fundamental transformation in forest governance and tenure is needed in countries where the forest policy is heavily geared towards industrial-scale timber extraction. Law enforcement is often weak in industrial concession forests, resulting in degradation of the forest resource through illegal practices by the concessionaires, such as cutting above quotas, cutting outside concession boundaries, felling undersized trees, and failing to comply with forestry codes (box 4.2). One major failure in forest governance is ensuring that the right's holder operates within the established limits. Weak compliance is only partly due to the inadequacy of resources allocated to forestry authorities to manage the vast expanses of state-owned forest. The allocation of industrial timber concessions was used as a means of "mobilising wealth to reward allies and engender patronage" and in the worst cases forest departments have become "clients of concession-holding industrial interests of the ruling elite, exercising their power as a form of private property rather than a public service" (Brack and Hayman 2001). A second failure of forest governance in some countries is the inequity associated with granting large-scale industrial concessions in forests that effectively deny access to local people who have depended heavily on forest resources, often for many generations.

3.2. Protection forests

ITTO Asia-Pacific producer countries report that 35% of their closed natural tropical forests are under protection (ITTO 2006). The purposes of protection include biodiversity, soil and water conservation. As with industrial concessions, protection forests are mostly poorly managed. Amongst these countries, only 11.6% of their area of protection forest has management plans and only 7.2% is considered sustainably managed (ITTO 2006, 51). Deforestation and timber felling in protection forests is organised by companies, local elites, the military and public officials, and often involves and affects local communities.

Large-scale organised illegal logging in protection forests is common in some Asia-Pacific forest-rich countries. For example, the Indonesian Ministry of Forestry found that illegal logging is occurring in 37 of the 41 national parks and that in the worst cases as much as half of the park area has been heavily logged (Nellemann et al. 2007). Illegal clearance by developers poses another serious threat to protection forests. Developers generally prefer to clear natural forest as the timber can provide an income while waiting for the trees to bear their first fruit or can be used to supply the company mills. Illegal oil palm plantation development, in particular, has impacted heavily on protected areas and is the primary cause of permanent rainforest loss in Indonesia and Malaysia (*ibid.*). When protection forests are illegally logged or cleared to establish plantations, park rangers find themselves in a difficult position in which they have insufficient numbers, arms, equipment and training to deal with the use of bribery or armed force (*ibid.*).

REDD could provide much needed resources to police the forest estate, provided illegal loggers are not operating under state protection. However, the design of national REDD systems must acknowledge that many poor indigenous and migrant communities also illegally harvest and clear protection forests for their survival. If REDD leads to a stricter enforcement of forest laws, it could push these communities into further poverty and ignite conflict.

Box 4.3. Potential opportunities and risks of REDD for protected area management in Indonesia

Forest resource

- The area of state forests is 133.1 million ha (Ministry of Forestry 2003), with an additional 8 million ha of forests excluded from state forests (Contreras-Hermosilla and Fay 2004).
- Indonesia is recognised as a mega-diversity country, with the most species-rich forests in Asia (World Bank 2006a).
- Forestry has contributed 3-4% of GDP or 20-24% of the industrial sector over the past ten years (*ibid.*).
- About 120 million people have been defined as forest-dependent (Ginting 2000 in Down to Earth 2002).
- 80% of the carbon stock in soils and vegetation is stored in standing forests (DFID/World Bank 2007).

Forest allocation

- Forests are divided into state forests (*Kawasan Hutan Negara*) and private forests (*Hutan Hak*).

- State forests include 61 million ha of production forests, 22.7 million ha of conversion forests, 30 million ha of protection forests and 19.5 million ha of conservation forests (Ministry of Forestry 2003).
- The legal classification of forests is based on official definitions of forest types and does not reflect ecological reality; 33 million ha of designated state forests are not covered by forest and significant areas are community planted agroforests, agricultural lands or grasslands (Contreras-Hermosilla and Fay 2005).

Deforestation and forest degradation

- The rate of deforestation is estimated at 1.6 to 2.5 million ha/year; 54.6 million ha of state forests and 41.7 million ha of non-state forests have been deforested (Baplan in Nawir et al. 2007).
- Significant direct causes of deforestation are illegal logging (about two-thirds of timber is from suspect or undocumented sources) (World Bank 2006a), establishment of oil palm plantations, conversion of forests to agricultural lands by smallholders, and mining and oil extraction. Market failure, policy failure or changes, and weak governance are amongst the underlying causes of deforestation (ibid.; Nawir et al. 2007).
- Indonesia is believed to be the third largest emitter of GHGs, primarily because of deforestation, peat land degradation and forest fires (DFID/World Bank 2007).

Governance, tenure and livelihoods

- Ownership of almost all of Indonesia's forests is claimed by the state.
- About 50-60 million people, who are mostly poor, live in state claimed forestlands and their rights to forest resources are uncertain and insecure (World Bank 2006a).
- The Government has granted exclusive forest rights to companies through licenses for natural production forests, thereby denying communities access to forestland and resources that they previously managed under *adat* (customary institutions).
- Forest laws and regulations (such as the Forestry Law of 1999) acknowledge the customary law (*Hak Ulayat*) of indigenous or local people. However, customary forests are not separately categorized within the Forest Zone but absorbed into state forests.
- Concessions were awarded in a non-transparent manner to a few well-connected actors and forest rights were allocated as political patronage, thereby concentrating economic and political power (Contreras-Hermosilla and Fay 2005).
- Conflict between local people who claim forest resource rights and industry and forestry officials has increased (ibid.).

Opportunities (✓) and risks (✗) of REDD for protected area management

- ✓ The Ministry of Forestry has designated protected areas for REDD piloting and placed national strategic priorities on protection forests in the Forestry Strategic Plan, 2005-2009.
- ✓ Protection forests in Indonesia may be well suited to REDD as protection (and conservation) forests are generally much healthier than conversion or production forests (World Bank 2006b).
- ✓ Protection forests are threatened by illegal logging and encroachment (EIA and Telapak 1999, 2000, 2001; Forest Watch Indonesia 2002) and would thus meet the requirement of additionality.
- ✓ REDD piloting in protected areas can build upon lessons learned from more progressive integrated conservation and development projects in Indonesia that engage local communities.
- ✓ REDD could provide the Government with additional resources and a financial incentive to more effectively manage protected areas, which would contribute to biodiversity conservation as well as climate mitigation.

- ✓ Conserving peat lands in Indonesia as conservation areas could be a particularly significant and low cost climate mitigation option. The annual CO₂ emissions from peat lands in Indonesia are estimated to be almost three times greater than the total emissions of Germany (Wetlands International 2006). Wetlands International estimates that carbon emissions reductions in peat lands in its project area in Central Kalimantan could be achieved for as little as Euros 0.50/t (ibid).
- ✗ Less progressive protected area management models driven by donors primarily concerned with conserving biodiversity have denied local people their rights to a livelihood and led to localised conflict. REDD could provide resources for more rigidly policing protected areas, thereby driving local people further into poverty and exacerbating conflict.
- ✗ REDD funds and credits could be captured by elite groups and thus weaken rather than strengthen forest governance.

3.3. Need for nuanced responses

Clearly, REDD needs to be elaborated to deal effectively with the different drivers of deforestation and forest degradation under different tenure arrangements in a manner that will satisfy both climate and sustainable development objectives. More fundamentally, however, REDD cannot overlook the fact that forest tenure arrangements have often not provided a foundation for sustainable forest management because of improper processes by which resource rights were acquired, the “fragility of granted rights” (FAO 2006b), inadequate monitoring of rights holders, and inadequate enforcement of forest regulations to ensure that rights holders do not exceed the limits of their rights. If REDD places narrow climate objectives ahead of sustainable development objectives, it could lead to a repeat of errors found in early protected area management models. Early protected area approaches, described by some critics as “fortress” conservation (Fisher et al. 2005, 20), sought to exclude rural people from forests, led to conflict and appeared to do little to stem the alarming rates of deforestation (Scheyvens et al. 2007). Griffiths (2007) rightly warns of the danger of “overzealous government support for anti-people and exclusionary models of forest conservation (evictions, expropriation) to protect lucrative forest carbon “reservoirs.”

4. Treatment of forests under the UNFCCC

The UNFCCC recognises the importance of forests in mitigating climate change and commits parties to promote sustainable management of sinks and reservoirs of all GHGs, including biomass, forests and oceans. The Kyoto Protocol, which complements the UNFCCC as an enforceable agreement for achieving GHG emissions targets, states that Annex I countries can promote sustainable forest management and establish new forests (through A/R) to contribute to achieving their targets. The Kyoto Protocol established a CDM that allows Annex 1 countries to invest in cost-effective emissions reductions in non-Annex I countries to meet their emissions targets. The CDM has the dual objectives of reducing the costs of emissions reduction and promoting sustainable development. Since the Kyoto Protocol entered into force in February 2005, the CDM has had little impact on the forest sector as methodologies are difficult to develop and investor interest beyond the first commitment period (2008-2012) is low (Hoota 2007). Current CDM rules allow only A/R and neither forest

management nor reduction of deforestation are eligible. By the end of February 2008, only one CDM project for A/R had been registered, compared with 701 energy projects. Projects to reduce emissions from deforestation and forest degradation were excluded from the CDM, but the negotiated outcome of the CDM provides some insight into how a future REDD scheme could evolve regarding its treatment of the rights and livelihoods of forest-dependent people.

The CDM sustainable development objective was elaborated for A/R projects through the modalities and procedures for addressing social and environmental impacts. Decision 19/CP.9 specifies policy elements needed for forestry projects and requires that project documents include, if applicable, "information on local communities, indigenous peoples, land tenure, local employment, food production, cultural and religious sites, and access to fuelwood and other forest products." The assessment of this information, however, is left to the designated national authority (DNA). Forner (2005) notes that most of the guidance provided by the modalities and procedures for A/R projects focuses on climate change issues (at the international level) and, because of concerns for national sovereignty, decisions on sustainable development are left to the national level. While the modalities and procedures for A/R CDM pay some attention to the livelihood needs of forest-dependent people, there is no independent scrutiny of the documentation provided on social impacts. The DNAs are responsible for certifying emission reductions or enhancement of removals, but not for certifying that the social impacts of the project are acceptable. The DNA decides whether projects are in accordance with national regulations and contribute to sustainable development, but there is no independent accreditation of DNAs to certify that they have the requisite expertise and are sufficiently neutral.

Decision 19/CP.9 provides for simplified modalities and procedures for small-scale A/R projects to assist community projects that could promote sustainable development. Reflecting the emphasis on sustainable development, small-scale projects must be developed by communities or individuals defined by the host party as low-income. This is another example of the CDM dichotomy leaving indexes of development to be decided by the host party, while climate parameters are set at the international level (Forner 2005).

This analysis suggests that climate-related parameters for REDD are likely to be set at the international level while sustainable development parameters relating to governance, tenure and livelihoods are likely to be decided and monitored at the national level. This would be a very undesirable outcome. In managing the forest estate, governments have often acted against the interests of forest-dependent communities in the pursuit of financial gains. If REDD follows the CDM in not requiring third party review of project documentation on sustainable development issues or independent monitoring of social impacts, governments attracted by the financial rewards for storing carbon in forests could return to the old socially unacceptable "fortress conservation" model of forest management.

4.1. Reasons for the exclusion of REDD from the CDM

The Kyoto Protocol required of the CDM (i) "real, measurable and long-term benefits related to the mitigation of climate change;" and (ii) "reductions in emissions that are additional to any that would occur in the absence of the certified project activity." The

Marrakech Accords reached at COP7 that specified the rules of meeting the Kyoto Protocol emission targets for the first commitment period restricted forestry activities to A/R on land that was not forested in 1990. The reasons for excluding REDD from the CDM included concerns over:

- (i) Leakage – REDD in one locality, without reducing demand for forest products, could prompt or accelerate deforestation elsewhere;
- (ii) Non-permanence – due to natural or anthropogenic disturbance, REDD might only be a temporary phenomenon;
- (iii) Monitoring and measurement uncertainties in estimating the carbon balance of a forest system;
- (iv) Additionality – determining how much deforestation and forest degradation was reduced and translating this into emissions reductions involves a high degree of uncertainty; and
- (v) Scale of reductions – the large scale of possible emission reductions by REDD could act as a disincentive for developed countries to reduce their industrial emissions.

4.2. Progress towards REDD

Irrespective of the low investor interest in A/R CDM, momentum for REDD is building and there is a growing consensus that the issues that kept REDD out of the Kyoto Protocol are no longer insurmountable. The movement to elevate REDD in UNFCCC deliberations began in December 2005 at the 11th Conference of the Parties and the first Meeting of the Parties to the Kyoto Protocol (COP11/MOP1) when the Coalition of Rainforest Nations led by Costa Rica and PNG presented a formal proposal for reducing GHG emissions from deforestation. COP11 subsequently requested the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) to examine the issue and to report its findings at COP13/MOP3 in Bali in December 2007. The UNFCCC organised two international workshops on reducing emissions from deforestation and requested COP13 to decide on treatment of REDD after the end of the first Kyoto Protocol commitment period.

REDD was high on the agenda of COP13 and was the focus of a number of side events, including the Forest Day organised by the Centre for International Forestry Research and the Indonesian Forestry Parallel Event. Three important outputs were the Summary of Forest Day presented by the Collaborative Partnership of Forests to the UNFCCC, the Bali Action Plan and the COP13 decision on “reducing emissions from deforestation in developing countries: approaches to stimulate action.” The Summary of Forest Day stressed that “governance-related challenges pose the greatest risks,” but that REDD could also provide an opportunity for achieving governance reforms, and that for REDD to distribute benefits equitably, it is essential to clarify land and carbon rights (Collaborative Partnership on Forests 2007). The Bali Action Plan stated that consideration should be given to “policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries” to enhance action on climate change mitigation (UNFCCC 2007). The COP13 decision on REDD paved the way for further work on REDD by encouraging Parties to build capacities for data collection, emissions estimates and monitoring and to undertake demonstration activities to enhance forest carbon stocks. It also requested the SBSTA to begin a programme of work on methodological issues, policy approaches and incentives.

Also, there is a growing sense of urgency that action should not be delayed until the end of the first Kyoto commitment period (2012). At COP13, the World Bank launched its Forest Carbon Partnership Facility (FCPF) to contribute to the development of a future, large-scale system of positive incentives for reducing emissions from deforestation by developing national capacities and supporting piloting at the project level. The FCPF aims to demonstrate and pilot mechanisms that generate lasting GHG emission reductions from forests that can be scaled up for REDD. The proposed FCPF consists of (i) a “readiness mechanism” (\$100 million) to assist about 20 developing tropical and sub-tropical countries to measure their carbon forest stocks, identify forest-related carbon emissions and prepare strategies; and (ii) a “carbon finance mechanism” (\$200 million) to facilitate payments to a smaller number of countries that achieve measurable and verifiable emission reductions by catalysing public and private purchases of credits. The facility’s resources reached \$165 million in December 2007.

Progress towards REDD is also evident at the national level. For example, in Indonesia the Ministry of Forestry initiated an Indonesia Forest Climate Alliance (IFCA) prior to COP13. IFCA has formulated a REDD methodology and strategies in collaboration with the UK, Austria and Germany.

4.3. Outstanding issues

Technical, methodological and market issues are far from resolved and require considerable progress before emissions reductions under REDD can be considered additional, measurable, verifiable and long-term. Parties have proposed a variety of solutions to the UNFCCC that reveal a wide divergence of views on the basic elements of REDD. At SBSTA-26 there were 22 distinct submissions on REDD and another 13 at SBSTA-27. The design of REDD must not only be credible; it must also be acceptable to all Parties. Difficult negotiations lie ahead. Three points of particular contention are REDD funding, level of implementation and scope.

4.3.1. *To trade or not to trade?*

How REDD should be funded is perhaps the issue over which the opinions of UNFCCC Parties are most clearly divided. The disagreement is over whether reductions generated from REDD should be tradable, and, if so, whether they should be traded in a separate market.

REDD proposals that argue for a non-market based approach have suggested various sources of funding including (i) official development assistance and voluntary contributions from governments and NGOs; (ii) private sector sponsorship/donations; (iii) potential new and additional financial resources under the UNFCCC; (iv) funds created under the Kyoto Protocol (e.g. the Special Climate Change Fund and the Adaptation Fund) and the Trust Fund of the Global Environment Facility; and (v) taxes on carbon-intensive commodities and services (SBSTA 2007). These funds could be tapped for the building of national REDD capacities or for implementing REDD pilot projects, but they cannot be expected to provide the large volume of funding required because of the opportunity costs of competing land-use alternatives. For eight countries that are collectively responsible for 70% of land use emissions, the Stern Review estimated that the opportunity costs of avoided deforestation would be about \$5 billion annually (Stern 2006, 217). While Robledo and Masera (2007) suggest that

inappropriate assumptions and a failure to value all forest functions makes this estimate too high, it is difficult to envision how a non-market based approach could provide the funds required. Official development assistance flows for the conservation of forests and biodiversity have decreased significantly (Khare et al. 2005) and other funds suggested for REDD are already being targeted by other climate change interests, such as adaptation.

Market-based approaches could theoretically provide greater resources for REDD than fund-based approaches. A variety of mechanisms have been suggested, including (i) trading of carbon credits; (ii) project-based, programmatic and/or sectoral CDM; (iii) barter transactions; (iv) payment for ecosystem services; and (v) levies on emission reduction units traded on the carbon market (SBSTA April 2007).

However, there are good reasons for questioning market-based approaches. First, as with A/R CDM, investors may steer clear of REDD because of the high methodological uncertainties, technical complexity and risks involved. Second, REDD could be a disincentive for Annex I countries to reduce their own emissions. Third, the integrity of carbon trading could be threatened if REDD credits are traded in the same market as other credits, due to the uncertainty of forest carbon balance estimations and permanence. Caps, discounts and a dual markets approach that separates REDD credits from others generated under the Kyoto Protocol have been proposed as possible solutions. Options to deal with non-permanence include banking a proportion of credits as insurance and temporary crediting, as applied to A/R CDM projects.

It is beyond the scope of this paper to review all the proposed funding mechanisms. Overall, a mixed basket of non-market and market-based financial resources could be the most realistic option for building capacities and providing positive incentives for REDD. Non-market funds are required to build the capacities of participating countries to establish national REDD systems (administration and enforcement costs) and further upfront financing is necessary to manage the transition (Stern 2006). An innovative market-based financing mechanism will be required to cover the opportunity costs of implementing REDD. To promote the wellbeing of forest-dependent people, a market-based mechanism should incorporate sustainable development concerns and not solely rest on price. Independent standards could play an important role.

4.3.2. National or project approach?

The PNG and Costa Rica proposal at COP11 indirectly referred to “compensated reductions,” a concept that is receiving growing support. A feature of compensated reductions is that, unlike CDM, implementation would take place at the national level, rather than at the project level, thus rewarding a government rather than a project proponent. Through its FCPF, the World Bank is seeking to build capacities for a national approach to establish a national accounting framework and a national reference scenario for deforestation and forest degradation emissions. A national approach would reduce, but not eliminate, leakage as the country or its entire national forest system is used as the unit of account. International leakage could be reduced by increasing the number of countries participating in REDD. A national approach would reduce the costs of baseline development (i.e., a baseline would only have to be developed at the national level, rather than for each project), monitoring and verification costs.

Nevertheless, a project-based approach remains attractive because countries with the highest rates of deforestation often have poor data sets for establishing baselines and suffer from weak governance. Of the ten countries with the highest rates of deforestation, only three have data sets for two years, which is the minimum required to estimate emissions trends (Karousakis and Corfee-Morlot 2007). Project approaches would avoid the costs of preparing national GHG inventories in accordance with IPCC guidelines. Although the potential for leakage in tropical countries is high, with most estimates exceeding 50% (ibid.), testing for whether leakage could be effectively monitored and dealt with on a project basis may still be fruitful. Project-level REDD is already being piloted by the World Bank in Colombia, Madagascar and Honduras using its BioCarbon Fund (World Bank 2007) and these and other REDD projects may offer important lessons. Whether rural communities could be mobilised to monitor leakage also deserves attention.

4.3.3. Deforestation only, deforestation plus forest degradation, or compensated conservation?

Some Parties to the UNFCCC advocate deforestation, others deforestation and forest degradation, and still others a system that rewards countries that have low rates of deforestation for their conservation strategies. Forest degradation is a particularly critical issue in the Asia-Pacific region where many natural forests set aside for sustainable harvesting are highly degraded because of inadequate compliance with forestry regulations by logging operators. Including forest degradation in a global climate framework would allow for broader participation by Parties and would enable a more complete valuing of the contribution of forest conservation to climate mitigation. A problem of current Kyoto Protocol definitions is that replacement of natural forests with planted forests is not considered deforestation. Recognition of forest degradation could capture this change in land cover and would remove the perverse incentive of REDD for countries to degrade their forests to just under the deforestation threshold. Despite the advantages of incorporating forest degradation in a post-2012 climate framework, major challenges regarding definitions, methodologies, monitoring and baselines have yet to be confronted (SBSTA 2007).

India presented a proposal to the UNFCCC employing the concept of compensated conservation, which argues for “providing compensation to countries for maintaining and increasing their forests” as a result of their existing forest conservation policies and measures (Government of India 2007). This would not meet the condition of additionality, though there is still disagreement among Parties over whether REDD should require it. Compensated conservation would enable participation from a greater number of developing countries in a forest climate mechanism, but might make this mechanism overly complex. For countries with low deforestation rates, efforts might be better directed at enhancing the technical and financial support provided for forest management through regional and international organisations such as the ITTO and FAO.

5. Capacity for, and benefits of, community participation in REDD

A review of REDD proposals reveals not only that there is still considerable disagreement over the basic elements of REDD, but also that little attention has been

given by UNFCCC Parties to the concerns raised in this chapter. Only a few proposals assert that communities will have an important role to play in REDD.

The discourse on REDD has been necessarily influenced by a concern for methodological rigour but this appears to have generated a search for technology intensive solutions, such as remote sensing, over potentially less costly and more socially desirable strategies that mobilise rural populations to monitor and control access to and use of forests. While technology intensive solutions may be appropriate for mitigation measures in other sectors such as energy, they may not be the most effective option for natural forest management, which must deal with the claims of competing interest groups including local and migrant communities, forest authorities, NGOs and national and international firms. Communities provided with the necessary training could participate in ground/field surveys and forest inventories. Payment for their involvement could provide significant development benefits and contribute to poverty alleviation. Productive engagement with communities in these tasks could increase their sense of project ownership and reduce the likelihood of conflict over forest resource allocation, while guaranteeing continued community access to non-timber forest products.

To achieve climate mitigation and sustainable development, REDD projects should require systems to be put in place to (i) ensure that the livelihoods of poor households are not diminished; (ii) control the exploitation of forests; and (iii) measure and report on carbon stocks. For REDD to be financially attractive, carbon prices will have to be sufficient to cover the opportunity cost of alternative land uses and the upfront and ongoing costs of establishing and operating the management, monitoring and reporting systems. For tropical forests, the opportunity costs may be relatively low. Research by the ASB-Partnership for the Tropical Forest Margins found that private users have a strong economic rationale for deforestation, but that the economic gains when expressed as tCO_2eq were small (Swallow et al. 2007). In three provinces of Indonesia the economic returns were less than $\$1/tCO_2eq$ for 6-20% of the area and less than $\$5/tCO_2eq$ for 64-94% of the area. The economic return was as low as $\$0.10-0.20/tCO_2eq$ on peat-rich soils where shifting agriculture is practiced (ibid.). The IPCC estimates that half of the forestry mitigation options could be implemented for less than $\$20/tCO_2eq$ (Nabuurs et al. 2007). Even if opportunity costs are low, however, transaction costs could be high, as experienced with A/R CDM. Involving communities in forest management and monitoring and reporting on carbon stocks could reduce transaction costs and optimise development benefits.

5.1. Communities managing and controlling access to and use of forests

For many years, communities were viewed by forest departments as agents of deforestation whose access to, and use of, forests needed to be controlled. This view has gradually, although with resistance, shifted towards an understanding that engaging communities in forest management, with appropriate incentives and controls, is more likely to achieve forest conservation than exclusionary models. Community-based forest management is now a central component of many national forest policies. Approximately 25% of forests in developing countries are owned or managed by local communities under long-term contractual agreements. Community management has doubled in the last 20 years and could reach 40% by 2050 (Kaimowitz 2005). In Nepal, 35% of the population are members of community forest user groups. The Government has handed over five million ha of forestlands to communities in the Philippines under

long-term lease agreements, and over 17 million people participate in Joint Forest Management in India (Scheyvens et al. 2007).

Commonly, community forestry programmes are characterised by co-management arrangements involving the forest department and local communities, renewable long-term lease agreements that define management and user rights, and some form of benefit sharing between the state and communities. Villagers benefit by having the legal rights to access and extract products from the forest, but are required to self-regulate to ensure the sustainable management of the resource. The experience of formal community forestry is that communities can (i) manage forests sustainably when tenure arrangements provide them with sufficient incentives; and (ii) contribute to the policing of access to and exploitation of forests (ibid.).

This experience suggests that less technology-intensive solutions could suit developing countries in the Asia-Pacific region, with resources directed towards engaging communities in controlling access to and exploitation of forests. For community forest management models, the returns from carbon forestry do not need to be too high as communities can derive a range of other benefits from forest management. Under “Kyoto: Think Global, Act Local”, a research and capacity building programme financed by the Netherlands Development Cooperation programme, five pilot projects trained forest-dependent communities to undertake assessments of the temporal changes in carbon stocks in their forests. The five projects found that prices as low as \$2-4/tCO₂eq could generate sufficient incentive for communities to participate (Murdiyarso and Skutsch 2006).

These additional returns for carbon sequestration may allow for community forestry on highly degraded forestland that previously has not been sufficiently attractive for community management. Communities may have a role to play in controlling access to protected areas that could be explored through REDD piloting. The financial rewards would have to be sufficient to pay communities for their services and to establish alternative livelihoods.

Community forest management models have their shortcomings and these need to be recognised. There are many examples in which communities are given responsibilities for protecting forest resources, but insufficient user rights or incentives to encourage their participation (Scheyvens et al. 2007). Moreover, community institutions are not always equitable, homogenous, or capable of deflecting external pressures. Built on trust and peer pressure, community institutions can be undermined by a single rule-breaker. Thus, the design of national level REDD schemes should be informed by a critical review of formal and informal community-based forest management models, with a view to identifying options for engaging communities in the implementation of REDD projects.

5.2. Communities monitoring and reporting on carbon stocks

The five “Kyoto: Think Global, Act Local” pilot projects found that even when local people have low levels of formal education, their capacity can be built quickly and cheaply to undertake measuring and monitoring of growth of biomass and carbon stocks. All case studies showed that local communities could do this reliably and accurately after a few days training using hand-held computers equipped with Geographical Information Systems (GIS) and Global Positioning Systems (GPS) to

map the forest areas and store data that are gathered by standard forest inventory methods (Murdiyarto and Skutsch 2006). The data collected provided the basis for the projection of carbon stock growth rates.

Communities could have a particularly important role in implementing REDD in degraded forests. Remote sensing can detect significant loss of forest canopy, but not degradation in the form of lost biomass below the canopy. Communities could provide accurate ground-level measurements for the development of baselines and carbon stock monitoring in degraded forests. An additional benefit of community participation in REDD is that, once trained, community members may be able to monitor forest growth rates accurately at a lower cost than professionals (*ibid.*, 122).

The experiences of community-based forest management and community carbon forestry indicate that (i) communities with a low level of formal education can be trained in a short period to measure and monitor carbon stocks; and (ii) even at low market prices, the economic valuation of carbon could provide communities with an important additional income source.

6. Employing multi-stakeholder processes and independent standards

In addition to engaging rural communities in implementing REDD, instruments that ensure that REDD does not have negative socio-economic impacts should also be explored during piloting. The World Bank states that national REDD strategies under the FCPF should “avoid any harm to local people and the environment and, where feasible (...) improve livelihoods” (World Bank 2007), but the design of these strategies should not be left solely in the hands of governments. Multi-stakeholder processes and the use of independent standards by accredited third party organisations to assess forest management could be a particularly strong mechanisms to ensure positive social, environmental and economic outcomes.

6.1. Multi-stakeholder processes

A trend towards employing multi-stakeholder processes to manage forests has emerged in recent years. This reflects a growing appreciation that governments have largely failed to manage forests sustainably through centralised and exclusive administrative structures and that involving other actors in forest management (i) allows for a fairer representation of interests in the allocation of forest rights; (ii) provides checks and balances; and (iii) introduces additional skills and knowledge to management. Various examples of multi-stakeholder forest processes can be found in the Asia-Pacific region that could provide important lessons for REDD.

For example, development of a national legality standard in Indonesia began in 2002 when the United Kingdom and Indonesia signed a memorandum of understanding that specified actions to adopt a working definition of illegal logging based on a multi-stakeholder process. The definition, or standard, is intended to make it easier for buyers to distinguish between legal and illegal timber products. The multi-stakeholder process engaged NGOs to undertake regional and national consultations and to field test the standards. The process has been drawn out and difficult but the strengths of

this approach can be seen in the breadth of issues covered by the standard, which includes provisions on land tenure and use rights, social and environmental impacts, as well as community relations and workers' rights. This experience suggests that a multi-stakeholder processes to design national REDD schemes and to select and manage forests set aside for REDD is likely to garner greater stakeholder buy-in and encompass a broader range of sustainable development concerns than if left entirely under government control.

6.2. Independent standards to guide forest management

The use of independent standards is already well advanced in the forestry sector in the form of forest certification, which combines a forest management standard with traceability and product labelling systems to distinguish products from well-managed forests. Although its early proponents were primarily concerned with the high rates of deforestation in tropical countries, forest certification standards have evolved to include social criteria such as the rights of indigenous peoples and forest-dependent communities and have the potential to contribute to sustainable poverty reduction through employment generation and the securing of subsistence livelihoods and environmental services. Independent standards have also been developed specifically for land management climate projects. Their application would be one way to ensure that REDD projects pay due consideration to the rights and livelihoods of forest-dependent communities (box 4.4).

Box 4.4. Independent standards for carbon forestry projects

Climate, Community and Biodiversity (CCB) Project Design Standards

An independent standard for land-based carbon mitigation projects, the CCB Standards are designed to: (i) “identify projects that simultaneously address climate change, support local communities and conserve biodiversity”; (ii) “promote excellence and innovation in project design”; and (iii) “mitigate risks for investors and increase funding opportunities for project developers”. The CCB Standards include 15 key criteria designed to ensure that a project will “help mitigate climate change, conserve biodiversity, and improve socio-economic conditions for local communities”. Independent third party auditors are used to certify projects that comply with the standards.

CarbonFix Standard

The CarbonFix Standard is an independent standard recently made available for public review by CarbonFix, a German NGO. The CarbonFix Standard only applies to afforestation and proposes granting “carbon futures” to provide an earlier financial reward for project managers. The Standard is intended to (i) enable project developers to finance their afforestation projects through the sale of CO₂-rights; and (ii) ensure these rights are generated from projects that have positive socioeconomic and ecological impacts.

Forest management will be assessed by certifiers from the Forest Stewardship Council (FSC) or UNFCCC designated operational entities. For projects greater than 2,000 ha, the standard stipulates that the socioeconomic prerequisites of the FSC forest management standard will be used. For project areas less than 2,000 ha, the socioeconomic prerequisite is a signed statement by a local authority and a registered national NGO active in the social sector that the project follows all national social laws and brings socioeconomic benefits to the local communities. Moreover, the project manager has to announce in a manner that best reaches local communities that any comments on the project can be sent directly to CarbonFix.

Source: <http://www.climate-standards.org>; <http://www.carbonfix.info>

The independent standards discussed here have an advantage over the modalities and procedures for addressing social impacts for CDM A/R projects as they provide for greater neutrality in assessing project documentation on social issues. The CCB Project Design Standards and the CarbonFix Standard’s treatment of projects greater than 2,000 ha, which require use of FSC socio-economic principles in the forest management standard, also provide criteria to guide socio-economic impact assessment.

Despite their potential to promote sustainable development through REDD, the application of these standards is constrained by their voluntary nature and thus their dependence upon market demand. The short history of forest certification, which is also a market-based, voluntary instrument, may offer some important lessons. Forest certification emerged in the early 1990s and, by 2006, 270 million ha of forest area had been certified, accounting for 7% of global forest cover (UNECE/FAO 2006). However, only 8% of the total certified area of forests lies in developing countries (Fischer et al.

2005, 13). The challenges to certify sustainable forest management are greatest in developing tropical countries and include (i) the ecological complexity of natural moist tropical forests; (ii) unclear or disputed tenure; (iii) a wide gap between existing management practices and certification standards; (iv) low capacity; (v) lack of policy support; (vi) uncertainty of price premiums; and (vii) inflexibility of standards (Fischer et al. 2005, 14,15; Durst et al. 2005, 4-6).

Forest certification is also limited on the demand side by low consumer awareness. Markets for certified timber and wood products are expanding, though market signals differ between countries and between products (Oliver 2005). Overall, the assumption that price premiums sufficient to cover the costs of certification would develop has not been met. Emergence of numerous competing forest certification schemes, each applying their own standards, is a further obstacle to market development.

The experience of forest certification suggests that a global REDD system should ideally include a comprehensive generic standard for management of REDD projects that could be tailored to the individual circumstances of each participating country, similar to the FSC's certification model. A market that favours such standards through a premium carbon price would be developed. However, this option is unlikely to win favour amongst UNFCCC Parties because it is difficult to implement and could be viewed as impinging on national sovereignty. If standards must remain voluntary and market-driven, a second best option would be for governments acquiring carbon credits through REDD to limit their purchases to projects that apply credible standards for sustainable forest management.

7. Conclusions and recommendations

7.1. Main messages

In forest-rich countries that stand to gain the most carbon credits from REDD, forest governance is often weak. Bluntly, this means that powerful business, government, military or other elites have undue influence over the allocation of forest resources and the distribution of benefits from forest exploitation. Millions of people dwelling in or near forests, marginalised from decision-making processes, suffer the consequences of this exploitation, whether formalised or illegal, in the form of diminished livelihoods and poverty. To maintain their existence they may resort to illegal forest activities such as clearance for agriculture.

The risks of REDD include (i) denying local people access to forests without providing alternative livelihoods, which would further exacerbate rural poverty, increase forest crime and lead to widespread conflict, thereby threatening the viability of REDD projects; (ii) channelling additional resources to elite groups who already enjoy disproportionate rewards from forest exploitation; and (iii) undermining the integrity of emissions trading through the uncertainties associated with estimating forest carbon balances, leakage, permanence and additionality. Irrespective of these risks, because of the lure of large international financial transfers envisioned, forest-rich developing countries experiencing high rates of deforestation are moving quickly to establish national REDD systems and to begin piloting at the project level. Although forest

conservation in the tropics needs to be approached with a sense of urgency, it also needs to be approached cautiously. Large international financial transfers have already been directed towards forest conservation but with little success in reducing rates of deforestation. Forest conservation requires more than financial resources. It requires strong and motivated government institutions and public support (Nabuurs et al. 2007). A well-designed REDD mechanism would thus not only contribute to reduced GHG emissions, it would also provide opportunities to reform forest governance and alleviate rural poverty.

Based on the proposition that REDD should combine climate mitigation and sustainable development objectives, the following conclusions can be drawn:

- (i) REDD should be positioned within a broader agenda of sustainable forest management that, as described in the Rio Forest Principles, is designed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations;
- (ii) As part of the development of national capacities for REDD, the security and equity of existing forest tenure arrangements should be reviewed and reformed where necessary;
- (iii) REDD pilot project demonstrations should explore strategies to build the capacities of rural communities to involve them in measuring and monitoring carbon stocks as well as to control access to, and use of, forests allocated for REDD projects;
- (iv) REDD pilot project demonstrations should introduce carbon forestry into community-based forest management models, paying attention to the equitable distribution of benefits between government and the community and within communities;
- (v) National multi-stakeholder processes, rather than governments acting alone, should collectively design national REDD schemes and decide upon which forests will be allocated for REDD projects; and
- (vi) REDD piloting should employ and promote development of independent standards and their use to audit the economic, social and environmental impacts of forest management.

7.2. Future research agenda

This chapter suggests a number of areas for future research. Further research is required to estimate the transaction costs of engaging communities in protecting forests for REDD and monitoring carbon stocks. This research should elaborate on optimal arrangements for assigning responsibilities to communities and employing technologies such as remote sensing. Nepstad et al. (2007) estimated that \$180 million year would be required to compensate “forest steward families” - indigenous groups, rubber tappers and other forest dwellers – and that \$13 million would be required for them to conduct perimeter patrols to protect forests in the Brazilian Amazon under REDD. More detailed research is now required to cost the engagement of communities in REDD for specific forests in the Asia-Pacific region and to compare the costs and benefits of this engagement with those of alternative approaches. Further action research is also required to test approaches to developing the capacity of communities to participate in REDD through forest monitoring and management as well as the measurement and monitoring of carbon stocks.

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¹ Carbon dioxide is the most significant GHG emitted by deforestation, followed by much lesser amounts of methane and carbon monoxide.

² Forest-dependent people are defined in this chapter as people residing close to or within forests whose subsistence or cash-based livelihoods depend to a significant degree on the utilisation of forest resources.

| CHAPTER 5 |

PROSPECTS AND CHALLENGES OF
BIOFUELS IN ASIA: POLICY IMPLICATIONS



Chapter 5

Prospects and Challenges of Biofuels in Asia: Policy Implications

1. Introduction

Biofuels have attracted worldwide interest for their potential as a substitute for fossil fuels. Fossil fuels have been rapidly depleted by global industrial development over the past century, prompting an urgent search for alternatives. According to a global oil company, at the current rate of extraction and utilization, global oil reserves will last only 40.5 years (Beyond Petroleum 2007). In the past few years many countries have adopted ambitious biofuel promotion policies. Governments are attracted to biofuels because of their potential contributions to (i) energy security; (ii) economic development and poverty reduction; and (iii) the environment, especially lower greenhouse gas (GHG) emissions, and air pollution. Biofuels might help Annex I countries of the United Nations Framework Convention on Climate Change (UNFCCC), such as Japan, to reduce their GHG emissions to comply with the Kyoto Protocol. Developing countries are mainly interested in reducing dependence on imported fuel (saving foreign exchange) and promoting economic development and poverty reduction, especially in rural areas. All countries hope that biofuels will provide a win-win-win strategy that can simultaneously promote energy security, economic development, and environmental protection.

The rush to promote biofuels, however, could be counterproductive if they are not sustainably produced.¹ There are widespread concerns that biofuels could end up causing more environmental or social problems than they solve. Recent studies widely circulated in the media have warned that biofuels might hurt food security (Graham-Harrison 2005), induce water shortages (Agence France-Presse 2007), worsen water pollution (Engelhaupt 2007), increase GHG emissions (Searchinger et al. 2008), and negatively affect biodiversity (Pearce 2005). It is also not clear if biofuel production consumes more energy (Lang 2005) than is produced, or if production and use of biofuels increases GHG emissions instead of reducing them. In short, biofuels are a clear example of a response to climate change that runs the risk of conflicting with sustainable development goals.

Currently, biofuels require subsidies, tariffs, fuel mandates, or other government support for economic viability. Thus, governments and consumers, or both, are paying a significant premium to gain the expected benefits from biofuels. The extent to which the expected benefits of costly biofuel promotion policies are being obtained is not clear, and if the expected benefits do not materialise, then it makes little sense to devote significant resources to them. For example, it would be tragic if money spent to promote biofuels ultimately financed rainforest destruction or worsened the living conditions of the poor. Conversely, if the benefits turn out to be greater than expected, it may be worth paying even more to attain them.

Initially, biofuel promotion policies in many countries focused on the potential for energy security, economic development, and short term economic benefits. Often, environmental obstacles or possible side effects, including the potential implications of land use change and effects on food security, were not adequately taken into account.

To date, little research has specifically addressed biofuels in the Asian context. This chapter reviews and analyses the current state of research on biofuel potential, especially in Asia, and develops policy recommendations based on this analysis. Section 2 discusses the relative advantages and disadvantages of different forms of biofuels compared to fossil fuels according to several environmental and economic criteria. Section 3 reviews and analyses current trends in biofuel production, consumption, and trade in selected Asian countries. Section 4 reviews and analyses current biofuel policies and section 5 concludes with policy recommendations.

2. Biofuel's potential: Promise or peril?

Box 5.1. What are biofuels?

Biofuel is a generic term referring to fuel derived from biomass such as plants and organic waste.

First generation biofuels are made from agricultural feedstocks, vegetable oils, and animal fats using conventional technology. The most common biofuels in commercial use are:

- Bioethanol – is blended with gasoline or petrol and produced by fermenting sugars or starches. Feedstocks include sugarcane, corn, wheat, and sugar beets.
- Biodiesel – is blended with petroleum diesel and produced from vegetable oil or animal fats. Feedstocks include oil from palm, jatropha, coconut, and soybeans.

Second generation biofuels are made from non-food feedstocks, including plant and wood waste (commonly called cellulosic biofuels), micro-algae, or other technologies that are currently advanced or experimental in nature.

The ability of biofuels (box 5.1) to contribute to GHG emissions reduction and other environmental goals, poverty reduction, rural development, and energy security, is a matter of considerable debate. Biofuels are more costly than fossil fuels, and it is important to address the question of whether the costs are worth the benefits, or whether the benefits will actually be realised. There are also concerns about food-fuel conflicts, resource availability and energy input required. This section addresses key issues raised in the debate from the perspective of the Asian region and focuses on first generation biofuels.

2.1. Environmental impacts

Biofuels can influence the environment in multiple ways and determining the net impact of biofuels on the environment is still challenging. Life Cycle Assessment (LCA)² studies have evaluated the GHG reduction potential of biofuels and whether they yield more energy than they take to produce (tables 5.1 and 5.2). There is considerable variation in

the results, as well as in the design of the studies (International Energy Agency 2004). Studies differ in terms of boundary conditions (e.g. what is included in the “life cycle”), whether they consider by-products, and assumptions about production methods.

Overall, LCA studies suggest that first generation biofuels have significant theoretical potential to reduce GHG emissions (table 5.1) and have higher net energy value than fossil fuels (table 5.2). Ethanol from sugarcane in Brazil and biodiesel from jatropha seem to have the most potential to reduce GHG emissions. LCA studies suggest that sugar based biofuels are superior to starch based ones (e.g. from corn) in terms of avoided GHG emissions (Blottnitz and Curran 2007).

Table 5.1. Comparison of feedstocks in terms of GHG emission reductions

Fuel	Country	CO ₂ (% reduction)	Source
Corn ethanol	US	2 (for E10) to 23 (for E85)	(Wang 2005)
Corn ethanol	US	-30	(Pimentel 2001) as quoted by International Energy Agency (2004)
Cassava	Thailand	63	(Nguyen et al. 2007)
Sugarcane	Brazil	80	(International Energy Agency 2004)
Oil palm	Malaysia	60	(Zutphen 2007)
Jatropha	India	80	(Hooda and Rawat 2006)
Coconut	Philippines	60	(Pascual and Tan 2004)

The Institute for Energy and Environmental Research in Germany concluded that all cultivated biofuels are positive in terms of their environmental benefits vis-à-vis their fossil fuel counterparts (Quirin et al. 2004). They further concluded that (i) ethyl tertiary-butyl ether (ETBE)³ is advantageous compared to bioethanol; (ii) bioethanol from sugarcane is the most favourable form of bioethanol; (iii) biodiesel from rapeseed is more favourable than pure rapeseed oil;⁴ and (iv) the comparison between bioethanol and biodiesel depends on the raw material used. Another review of the environmental benefits of biofuels in Brazil, the European Union (EU) and the USA by the International Energy Agency (IEA) reported a significant reduction in GHG emissions from biofuels (International Energy Agency 2004). The review categorically stated that there are net GHG reductions from both bioethanol and biodiesel.

Table 5.2. Comparison of feedstocks in terms of Net Energy Value (NEV)⁵

Feedstock	Country	NEV (MJ/L)	Source
Corn	US	5.89	(Shapouri et al. 2002)
Corn	US	-6.17	(Pimentel 2003)
Cassava	China	15.14	(Hu et al. 2004)
Cassava	Thailand	22.38	(Nguyen et al. 2007)
Sugarcane	Brazil	41.34	(Macedo et al. 2004)
Oil palm	Malaysia	37.45	(Zutphen 2007)
Jatropha	Thailand	3.82	(Prueksakorn and Gheewala 2006)
Jatropha	India	5.26	(Tobin 2005)
Coconut	Philippines	31.72	(Tan et al. 2004)

One controversial study reported that biofuels have negative environmental benefits and energy balances (Pimentel 2002). In response, the US National Biodiesel Board identified several weaknesses in the Pimentel study, including insufficient background information, outdated energy input data for biofuel production, incorrectly considering farm labour as equivalent to fossil energy, ignoring the by-products of ethanol production, and inaccurate consideration of corn production practices (National Biodiesel Board 2005). While reporting positive GHG reductions, another study reported greater environmental impacts from biofuels than fossil fuels due to land use change, such as the conversion of tropical forests to farm land, which may lead to the release of large quantities of carbon dioxide (CO₂) and cause increased air and water pollution and biodiversity loss (Zah et al. 2007).

Significant variation in LCA results for biofuels is expected as the GHG reduction potential will be determined by a wide range of factors, including production methods, distance between the biofuel refinery and the feedstock location, and yield. Yield, in turn, is dependent on factors such as land quality, water availability, fertiliser application, and weather. For example, the GHG reduction potential for the same crop planted on a given piece of land in a given country could vary from year to year depending on the weather.

Many LCA studies may not be applicable to Asia because they are either based on data from countries outside Asia where production processes are different, or are based on assumed values under ideal conditions. Since environmental and energy performance of biofuels depends on various factors, such as agricultural production practices, refining technologies and feedstock sources, the actual performance of biofuels in various Asian areas could be better or worse than indicated by existing studies.

On one hand, GHG emissions from biofuels could be lower in some parts of Asia, since many developing countries employ less energy and other inputs in crop production. The average fertiliser use for maize in North America and Western Europe is 257 kg/ha and 276 kg/ha, respectively, while it is only 117 kg/ha in Asia. Even this average figure could be misleading as countries such as Japan use much more fertiliser per capita than developing countries in the region (Food and Agricultural Organization 2006). To compare farm energy use, fossil fuels (gasoline and diesel) constitute 75% of total agricultural energy use in the USA (Brown and Neal 2005), while in Asian developing countries most farm energy still comes from animal and human power, followed by electricity and diesel (Makhijani 1990).

On the other hand, GHG emissions from biofuels in Asia could also be higher, since energy use in production may be less efficient. For example, India uses significantly more energy to produce a tonne (t) of corn compared to the USA; India uses 4,653 MJ/t of energy for corn (Ali 2006), while the USA uses 4,168 (Pimentel 2003) or 2,068 MJ/t (Shapouri et al. 2002). Also, GHG emissions from animal power have not been determined, and infrastructure for transporting biofuel feedstocks could be more efficient in countries outside Asia. Thus, there is an urgent need to conduct lifecycle studies within an Asian context.

One important factor left out of most LCA studies is the impact of increased biofuel feedstock cultivation on land use change, especially rainforest destruction and conversion of bogs and peat lands to arable cropping. Therefore, existing LCA studies may significantly underestimate the negative effects of biofuels on GHG emissions. One recent study that focuses on the effects of land use change concludes that if land use changes are accounted for, biofuels result in as much as 50% higher GHG emissions when compared to fossil fuels (Searchinger et al. 2008). In a letter to the Intergovernmental Panel on Climate Change (IPCC), Pimentel et al. (2007) pointed out

that biofuels will be unsustainable even if they are produced in small areas, as it usually means taking away fertile lands from agricultural use, leading to deforestation and land use change related to GHG emissions (Pimentel et al. 2007). There is an emerging consensus that increased GHG emissions from rainforest destruction will be significantly more than the GHG emissions that will be saved by replacing rainforests with biofuel crops (Fargione et al. 2008). It has been estimated that the peat lands in Southeast Asia store about 42,000 Mt of carbon which could potentially be released into the atmosphere if they are converted to palm oil production (Hooijer et al. 2006). Therefore, prevention of the conversion of rainforests and peat lands to biofuel production is an important priority.

Biofuels may have other potential impacts on biodiversity and air and water quality. These effects have not been studied as extensively by LCA analysis as the energy balance and GHG emissions. Biodiversity will be threatened by large scale production of monoculture biofuel crops, especially if it involves extensive destruction of rainforests (Bergsma et al. 2006). Therefore, there may be complex tradeoffs between biodiversity and GHG emissions reduction. Water quality may also be negatively affected by the large scale production of biofuels, due to greater fertiliser use in feedstock production and effluents from processing industries.

Current LCA studies have been criticised for not clearly considering policies or economic effects; basically they assume a narrowly defined set of activities replacing existing practices (Delucchi 2003). It is likely that the impacts of different life cycle stages may be affected by various government policies or economic conditions. These may vary over time, across countries, or even within countries. Comprehensive LCA studies are required that cover broad timescales; different transportation modes, vehicle drive train types, fuels, and feedstocks; lifecycle of vehicles using the fuel; condition of the infrastructure under which each kind of fuel will be used; and effects of other policies, such as pricing policy, that may produce effects not directly related to the fuel. Also, LCA studies should include impacts such as deforestation of tropical rainforests and land use changes, and assign imputed costs to possible environmental problems such as biodiversity loss.

2.2. Food-fuel conflicts and resource availability

Even assuming that biofuels can help to significantly reduce GHG emissions, it will be difficult to justify them if their promotion significantly contributes to skyrocketing food prices – the food-fuel conflict. Diversion of land and food crops to biofuels could result in escalating food prices (Msangi et al. 2006; Food and Agricultural Policy Research Institute 2005; Rajagopal and Zilberman 2007), especially in conjunction with several other factors contributing to rising food prices such as increasing population and bad weather. The food-fuel conflict appears to be already occurring, partly due to the conversion of agricultural land from food crops to biofuel crops.⁶ Currently rising prices for corn, cassava, and sugar are indicative of what may transpire as many countries try to meet increasing fuel demands through biofuels. In the USA, corn prices have risen by 42% since 2002, reaching a peak of \$139/t in 2006 (United States Department of Agriculture 2007). In Brazil, the world's largest producer of sugar and ethanol from sugarcane, sugar prices have risen 303% from \$125/t in 2004 to \$506/t in 2006 (Center for Advanced Studies on Applied Economics 2007). These changes have been primarily attributed to the conversion of corn and other food products to biofuel production with 50% of sugarcane going into ethanol production (Schmitz et al. 2003). The International Food Policy Research Institute (IFPRI) forecasts a further increase in prices of corn by 26% and oilseeds by 18% due to the planned global expansion of

biofuels (Braun 2007). Under a drastic biofuel expansion scenario, prices of corn and oilseeds could rise as much as 72% and 44%, respectively. A similar increase in global palm oil prices has been forecasted (Bhardwaj 2007). For each 1% increase in primary staple food prices, poor people are estimated to reduce consumption by 0.75 percentage points (Regmi 2001). With reduced food consumption due to higher prices, there could be a drastic increase in the incidence of hunger, conflicting with the sustainable development principles intended to alleviate global poverty and hunger.

The food-fuel conflict has led to a search for feedstocks that can be grown on unused marginal lands or wastelands, areas that cannot be used for growing food crops, and thus may not pose a threat to food security. Many Asian countries are therefore considering jatropha as an alternative feedstock, since it can grow on wastelands and does not require much water. However, while jatropha may not need significant amounts of water to survive, it does need more water and fertilisers to increase the yield of seeds and oil. Moreover, jatropha will do better on higher quality land, so there are concerns that it may be difficult to limit jatropha to wastelands. But jatropha's current low productivity will limit incentives to plant it on higher quality land without subsidies or other policy support. It is also uncertain to what extent available "marginal lands" or "wastelands" are actually unused in many Asian countries, which suffer from intense population pressure. These areas may be used for subsistence crops or livestock grazing by poor people without secure tenure. Shifting the land to commercial uses like jatropha plantations may further disenfranchise the landless poor.

Finally, in the context of first generation biofuels, the logic of focusing on a crop that cannot be used for food, solely as a way to avoid the food-fuel conflict, is not entirely convincing. If a large market is developed for an inedible fuel crop like jatropha, it is unlikely that it would be possible to limit its cultivation to "wastelands," and its cultivation may spread to better quality land and displace food crops. There will be intense pressure to reduce costs and increase profits by cultivating it on higher quality arable land to obtain higher yields.

The potential of biofuels to meet global energy requirements is physically very limited (table 5.3). Only about 57% of total fossil fuel requirements could be met even if the entire global land area under major food crops was used for ethanol production (Rajagopal et al. 2007). Hence, countries should consider additional energy sources in their energy policy.

Table 5.3. Global potential of ethanol from principal grain and sugar crops

Crop	Global area (Mha)	Global average yield (t/ha)	Global production (Mt)	Conversion efficiency (L/t)	Land intensity (L/ha)	Max. ethanol (billion L)	Gasoline equivalent (billion L)	Supply as % of 2003 global gasoline use (%)
Wheat	215	2.8	602	340	952	205	137	12
Rice	150	4.2	630	430	1806	271	182	16
Corn	145	4.9	711	400	1960	284	190	17
Sorghum	45	1.3	59	380	494	22	15	1
Sugarcane	20	65.0	1300	70	4550	91	61	6
Cassava	19	12.0	219	180	2070	39	26	2
Sugar beets	5.4	46.0	248	110	5060	27	18	2
Total	599					940	630	57

Source: Rajagopal et al. (2007).

Biofuel production will require additional use of land, water, and fertiliser. Adequate land, water, and other resources to produce biofuels on a large scale in Asia may not be widely available, especially if the food-fuel conflict is to be minimised. Many areas of Asia already suffer from severe shortages of land and water, so there is a potential for conflicts over alternative uses for them (Fritsche et al. 2006; Bergsma et al. 2006). Some Asian countries do have abundant human resources that could be employed in biofuel production, but labour intensive production methods may not always be the most economically efficient, depending on local conditions.

It is often overlooked that additional fertiliser use will be needed to significantly increase biofuel crop production in many areas of Asia. According to our estimates, India, where jatropha is being promoted for biodiesel production, will require an additional 14.9 Mt of organic manure and 2.6 Mt of fertiliser per year to meet its production target of 13.4 Mt of biodiesel by 2012. Such increased fertiliser use will reduce the GHG benefits as well as the cost effectiveness of biofuel production, even though the fertiliser rates assumed are based on recommended doses. To minimise GHG emissions, countries would have to use fertilisers more sparingly by enhancing overall efficiency.

The additional demand for land and resources would have to be met either by productivity enhancement of existing crops (vertical expansion) so that some land can be converted to biofuel production or, by physically expanding the amount of available agricultural land (horizontal expansion) by cutting down forests and bringing fragile ecosystems into commercial production, which may cause irreversible damage to the environment. Such potential resource conflicts illustrate the extent to which climate change responses can deviate from sustainable development, if they are considered in isolation of other development needs and priorities.

2.3. Poverty reduction and rural development

Poverty reduction, a key objective of sustainable development, is one benefit claimed by those promoting biofuels in the region. Biofuels could increase employment under the following conditions: (i) if more labour intensive production methods are used; (ii) if biofuel refining infrastructure is developed locally; (iii) if a significant share of biofuels are produced and consumed locally; and (iv) if biofuel production promotes the utilisation of previously unused land.

However, the contribution of biofuels to poverty reduction and sustainable rural development is very uncertain. Biofuel production may be capital intensive if biofuel production is dominated by large producers; if so, farmers and workers may suffer from increased inequality and income disparity, unsafe or worsened working conditions, and they may even end up losing their land (Ankumu 2007; Friends of the Earth 2008). Most of the current speculative interest in biofuels from private sector investors targets projects that are likely to be very large scale and tightly focused on achieving low costs of production, not poverty reduction or the use of sustainable production methods (Hazell and Braun 2006). In some cases, these could involve capital intensive production methods which make little contribution to employment. This does not mean that biofuels cannot be produced in a sustainable and cost effective way through labour intensive production methods. However, if governments want to prioritise sustainable development goals like poverty reduction and employment generation through biofuel

promotion, then policies may need to be designed to encourage more labour intensive production methods. But if a government does this, it is important to keep in mind that, depending on local conditions, the cost to the government may be higher (compared to the market cost) if labour intensive production methods are not the most efficient.

2.4. Cost of biofuel production and prices

Broadly speaking, biofuels are currently more expensive than fossil fuels, although the magnitude of the price differential varies widely according to the cost of local inputs, feedstock productivity and productivity of other factors of production. According to one assessment, biodiesel is about \$0.27 per litre of diesel equivalent⁷ more expensive than regular diesel (Duncan 2003; Organisation for Economic Co-operation and Development 2007). The costs would be even higher if environmental costs and subsidies were also included (Organisation for Economic Co-operation and Development-International Transport Forum Round Table 2007). The main reason for the higher cost of biofuel is the cost of feedstock production, which constitutes more than half of biofuel production costs (Kojima et al. 2007). The higher feedstock production costs are in turn due to high prices of inputs including fertiliser and energy, low recovery of biofuel from the feedstock, and availability of a narrow range of inputs for biofuel production (Runge and Senauer 2007). Part of the higher feedstock prices is also due to competing demand for their use both as food and fuel. Brazil is the world's biofuel cost leader; the cost of production of its bioethanol is up to 50% cheaper than the global average, mostly due to energy co-generation, higher productivity of sugarcane, and cheaper labour (Valdes 2007). Like Brazil, some Asian countries may be able to lower biofuel production costs by using abundant cheap labour.

Biofuel prices are already cheaper than fossil fuel prices in some Asian countries. For example, in 2006, the government of India set a purchase price of \$0.68 per litre of diesel equivalent for the oil distribution companies compared to a retail price of \$0.76 per litre of diesel oil (Ministry of Petroleum and Natural Gas 2005). The price differences are due to differences in feedstock prices, farm subsidies, and fossil fuel prices. As fossil fuel prices increase, biofuels will become more competitive, and if they rise high enough, biofuels will become commercially profitable without government policy support. For example, ethanol could be profitable in China if the cost of fossil-based fuel reaches \$0.79 per litre (Koizumi and Ohga 2007). Similarly, bioethanol will be profitable in New Zealand only if petrol is taxed (Denne and Hole 2006). Bioethanol and biodiesel in the EU will be competitive if oil prices are above \$0.71 and \$0.48 per litre, respectively (National Farmers Union 2006). In the long run, the competitiveness of biofuels is expected to increase along with corresponding declines in their prices as the range of potential feedstocks increases, and as large-scale efficient production plants are established (Steenblik 2007).

Since biofuels are generally more costly than fossil fuels, consumers will only use them if the cost is compensated by the government or if they are forced to. Most governments that promote the use of biofuels use some combination of subsidies, tariffs, fuel taxes (and tax exemptions), and blending mandates, so that the actual price of biofuels is about the same, or even lower, than the price of fossil fuels. This extra cost, regardless of who pays it or how, effectively pays for the policy goals that the government is trying to achieve, as well as any unintended effects from their production and use. A price premium for biofuels would make sense only if enough policy benefits

can be achieved. However, if global crude oil prices increase further and biofuels become economically competitive, the rush to biofuels may accelerate without concern for environmental impacts or sustainable development.

2.5. Promise or peril?

In sum, first generation biofuels appear to have some potential benefits on all sustainable development criteria (economic, environmental, social), but whether they can be realised depends on the details, particularly the feedstock, production method, and the economic organisation of production. Therefore, policy intervention will be important to realise the promise of biofuels and minimise their perils.

It is widely agreed that so-called second generation biofuels, however, have significantly more potential for reducing GHG emissions and avoiding the food-fuel conflict (Worldwatch Institute 2007). They can be produced from a wider range of sources including agricultural, forest, some municipal and other waste, and micro-algae. To the extent that agricultural feedstocks are used, second generation biofuels will encounter similar limitations as first generation ones; for example, they will still use fertiliser and pesticide. However, the yield of usable material will be much higher since they use lignocelluloses, meaning the entire plant can be used, not just grains or oilseeds.

The wide availability of cellulosic feedstocks may make second generation biofuels a promising proposition for energy security. However, realising the full potential of second generation biofuels requires overcoming several limitations. These include the need for research breakthroughs to improve feedstocks and conversion processes, reduce the necessary scale of the processing facilities, and reduce costs, especially for transporting widely dispersed bulky feedstock. Moreover, second generation biofuels are not free from environmental impacts. Collection of stover and other crop residues from fields will deprive soils of necessary organic matter and make them more vulnerable to soil degradation and erosion, leading to reduced productivity. The problem could be more severe in tropical developing countries where organic matter decomposes faster in the soil, so more organic material is needed to maintain soil quality. Many peasant farmers in the region depend on these crop residues and other organic matter as a main source of plant nutrients. If second generation biofuels reduce the availability of organic matter, farmers could be forced to use more fertilisers to sustain crop yields. Biodiversity could be endangered if forest residues are collected from vulnerable areas. Forest litter collection could also expose forests to soil erosion and degradation (Graham et al. 2007; United Nations Conference on Trade and Development 2007; Wright and Brown 2007; Runge 2007). It has been suggested that some of these issues could be addressed by returning the inorganic residues from biofuel processing back to the soil (Tono et al. 2007). However, this may be only a partial solution since the organic matter would still not be available for agricultural use. The transition to second generation biofuels is also an issue since large investments in production of first generation biofuels may already have been made by the time the second generation biofuels can achieve significant scale. The United Nations Commission on Trade and Development (UNCTAD) believes second generation biofuels will take 20-30 years to be commercially viable, but by then it may be difficult for them to compete if large infrastructure investments in first generation biofuels have already been made.

Despite these limitations, some are optimistic about second generation biofuels, since there has been significant investment in research efforts for some time. One example is an effort to produce cellulosic ethanol by using a well established technology that has been used mainly for producing diesel from coal (United Nations Conference on Trade and Development 2007). Ideally, it would be best if biofuels could be produced from municipal and agricultural waste rather than specifically designated crops (Bensten et al. 2006). Biofuels would be much more attractive if they could help solve Asia's municipal waste problems or help address issues stemming from increased livestock waste due to increased meat consumption and production. However, none of these sources will be commercially viable without research breakthroughs. Although there are intensive research efforts and many demonstration projects underway around the world, the general consensus is that large scale utilisation will not be possible for at least several years.

3. Biofuel production and consumption trends in selected Asian countries

3.1. First generation biofuels

3.1.1. Current status

In a number of countries in Asia, governments and the private sector already have ambitious plans to rapidly expand the production and consumption of first generation biofuels. Indonesia and Malaysia have bold plans to produce biodiesel from oil palm. China and India are experimenting with different feedstocks for biofuels. The Philippines is focusing on biodiesel from coconut oil and ethanol from sugarcane. Thailand and Pakistan are also likely to become important future players. Japan is not yet a major player, although it has conducted considerable research, and is focusing on developing second generation biofuel technology based on cellulosic biomass.

The quality of data available on biofuel production, consumption, and feedstock utilisation in the Asian region is not very high. Data on biodiesel is especially scarce. Only rough estimates of biofuel consumption are available. Better data on production, sales, trade, and inventories of biofuels is needed, especially internationally comparable standardised country-level data.

Globally, it is estimated that bioethanol constitutes 90% of biofuel produced, at 36 billion litres per year (L/yr), and biodiesel constitutes 10%, or 4 billion L/yr (Rajagopal and Zilberman 2007). This is about 1% of the total global transport fuel market. The production and consumption of biofuels is expected to grow further, both worldwide and in the Asia Pacific region, along with the rising energy demand and fossil fuel prices.

Biofuels are increasingly used in the region's transportation sector. In 2004, on average, about 1.06% of total transport fuel came from biofuels in countries such as India, China, Pakistan, Thailand, the Philippines, Russia, Indonesia, the Republic of Korea, and Japan (Worldwatch Institute 2007). India topped the list with 3.01% of the transport fuel coming from biofuels, followed by China (2.51%).

The choice of feedstock in Asian countries has been based on existing crops, existing feedstock production and processing infrastructure, climatic conditions, and, in some cases, government policies. It has not necessarily been based on which crop makes the best feedstock in terms of efficiency, cost of production, or potential for GHG emissions reduction. Currently, sugarcane and oil palm are the most important feedstock crops for bioethanol and biodiesel production, respectively. Although cassava has the highest bioethanol production potential per hectare, the area under cassava cultivation is considerably smaller than sugarcane. Oil palm produces the highest amount of biodiesel per hectare followed by jatropha and coconut.

3.1.2. Production potential

Tables 5.4 and 5.5 provide estimates of the amounts of bioethanol and biodiesel that could be produced by various countries in Asia, if all the land currently being used to produce a particular crop was converted to biofuel production. Under this hypothetical scenario, China and Indonesia currently produce only 7% of their theoretical bioethanol potential followed by Thailand (5%), India (4%) and the Philippines (2%). In 2004, the fossil fuel demand for the Asian region (excluding Japan and the Republic of Korea) was 825 billion litres, and roughly 65% was utilised for transport (International Energy Agency 2004). Therefore, even if the entire crop area in tables 5.4 and 5.5 were converted to biofuel production, only about 33% of transport fuel could be replaced with bioethanol or biodiesel, and if 10% of the crop area were converted, then only 3% of transport fuel could be replaced. Therefore, first generation biofuels cannot be the main solution for the region's increasing transportation energy needs.

Table 5.4. Bioethanol production potential from first generation feedstocks in selected Asian countries

Country	Feedstock	Total crop area in 2005* (Mha)	Ethanol yield** (L/ha)	Bioethanol production potential*** (ML)	Current ethanol production (ML)	Current production as % of potential
China	Corn	26.0	2,088	55.0	4,000	7
	Sweet Sorghum	1.0	380	0.4		
	Cassava	0.2	3,177	0.7		
India	Sugarcane	4.0	5,434 (Gonsalves 2006)	22.0	2,000	4
	Sorghum	9.0	3,469	32.0		
Indonesia	Cassava	1.0	2,465 (USDA Foreign Agricultural Service 2007b))	3.0	200	7
Philippines	Sugarcane	0.4	4,349	2.0	100	2
	Cassava	0.2	1,474	0.3		
	Corn	2.0	2,960	6.0		
Thailand	Sugarcane	1.0	3,252 (Dutta et al. 2007)	3.0	400	5
	Cassava	1.0	5,721 (Nguyen et al. 2007)	6.0		

Note: * Food and Agricultural Organization (2007); **Ethanol yield was obtained from different sources (USDA Foreign Agricultural Service 2007a); *** Potential production of bioethanol was obtained by multiplying the current crop area and ethanol yield per hectare.

Table 5.5. Biodiesel production potential from first generation feedstocks in selected Asian countries

Country	Feedstock	Total area* (Mha)	Biodiesel yield** (L/ha)	Biodiesel production potential*** (ML)
Philippines	Coconut	3.2	1,750	6,000
Thailand	Oil palm	0.3	3,800	1,000
Indonesia	Oil palm	3.7	3,800	14,000
	Coconut	2.7	1,750	5,000
	Soybean	0.6	320	200
India#	Jatropha	@ 13.4	1,892 (Rajagopal et al. 2005)	25,000

Note: * Food and Agricultural Organization (2007); ** Obtained from different sources, averaged if given as a range; *** Obtained by multiplying the current crop area with ethanol yield per hectare; NA: data not available; # Production is still in the pilot phase; @ area envisaged to be covered by the government of India.

3.2. Second generation biofuels

3.2.1. Current status

Acknowledging the limitations of the first generation biofuels, there is a move in the direction of second generation biofuels. The European Commission, which is currently developing rules requiring biofuels used in the EU to produce at least a 10% saving of GHG emissions compared to fossil fuels, would encourage the use of second-generation biofuels, possibly by giving them extra weight towards EU targets and providing more government support (Mason 2007). The 2007 U.S. Energy Bill mandates the blending of 136.3 billion litres per year of domestic alternative fuels into motor fuels by 2022, and calls for the share of cellulosic ethanol to reach at least 3% by 2012 and 44% by 2022 (Gardner 2007). Japan emphasizes the importance of biomass from waste and unutilised sources.⁸ The government of Japan estimated that if technologies to produce ethanol from rice straw and lumber on a mass scale are realised, it would be possible to produce 1.8-2.0 billion litres of ethanol from herbaceous crops and 2.0-2.2 billion litres from wood-based material (Biomass Nippon Strategy Promotion Conference 2007). Another estimate suggests that Japan could supply 24.7 Mt of woody biomass from timber mill residues, construction waste, forest waste and low quality wood that cannot be used for economic purposes (Inoue 2007). With a conversion rate of 303 L/t of woody mass, Japan could produce 7.5 billion litres of cellulosic ethanol, constituting 3.4% of the total oil consumed in 2006.

In terms of large-scale production, biofuels from cellulosic biomass are still at the demonstration stage. Research has been conducted focusing on large-scale production in the USA, Canada, Germany, Sweden, China and Brazil (World Business Council for Sustainable Development 2007). It was previously believed that second generation biofuel technologies would not be available in the market until 2030. However, the World Business Council for Sustainable Development (WBCSD) believes that technological breakthroughs are possible in the near future depending on government funding (World Business Council for Sustainable Development 2007).

Box 5.2. Production of bio-ethanol from construction waste wood

Japan has several pilot projects to explore the potential of second generation biofuels. One example is Bioethanol Japan Kansai (BJK), founded by Taisei Construction Company, Marubeni, Tokyo Board, Daiei Environment, and Sapporo Beer. This project uses construction waste timber, which it calls “forest resources stocked in cities.” The ethanol produced is being sold as 3% ethanol blended gasoline (E3) at gas stations in Osaka Prefecture. The bioethanol production facility, which was constructed with the support of the Ministry of Environment, Japan, is one of the core industries of the “eco-town” promoted by Osaka Prefecture. Currently, it is possible to produce 1.4 ML per year by using 40,000 – 50,000 t/yr of waste wood (Sato 2007). Like other similar projects, this one is not commercially viable.

3.2.2. Production potential

India, Indonesia, China, Malaysia, Japan and Vietnam together could produce about 402 billion litres of ethanol by collecting the residues from rice, wheat, sugarcane and corn alone (Table 5.6). There is potential to produce even more if residues from other agricultural crops, timber mills, forests, grasslands and organic waste from urban and rural areas are included.

Table 5.6. Potential availability of agricultural residues for second generation biofuels in selected Asian countries

Crop	Residue type	India	Indonesia	China	Malaysia	Japan	Vietnam
Rice	Straw, husk	229	90	303	4	19	60
Wheat	Straw, husk	110	-	156	-	1	-
Sugarcane	Leaves, bagasse	119	15	44	-	1	8
Corn	Stalks, cobs, leaves, husk	14	13	140	0.1	0	4
Total residues (Mt per year)		472	117	643	4	21	71
Cellulosic ethanol* (billion litres per year)		143	35	195	1	6	21

Notes: * Using a conversion rate of 303 L/t of cellulosic residue material. Conversion rates can vary from feedstock to feedstock and thus this should be considered as a rough estimate. Crop yield for 2005 was sourced from the FAOSTAT database. Residues were obtained from harvest index values and biomass distribution in the above ground mass from different sources.

4. Biofuel-related policies in selected Asian countries**4.1. National policies in selected Asian countries**

Many Asian countries have already instituted ambitious policies to promote biofuels. This has been mainly motivated by economic factors, including the need to meet increasing demand for transport fuel and enhance energy security in the face of rapid population and economic growth. In some countries, biofuel promotion was also motivated by potential export opportunities to the EU.

Policy measures include supply and demand stimulation, formal targets for biofuel usage, mandates to blend biofuels with standard gasoline or diesel, tax advantages, or other industrial promotion measures (Clark 2007a; Kojima et al. 2007). Some countries, including China, have become aware of the potential tradeoffs between biofuels and food, and have started to adjust policies to resolve this issue. Many countries are using trade policies, especially infant industry protection in order to promote domestically produced biofuels. Some countries, like Indonesia, are considering export tariffs to encourage biofuels to be used domestically instead of being exported.

This section reviews the main biofuel-related policies in selected Asian countries, especially focusing on formal numerical targets, fuel blending mandates, economic incentives to promote biofuels, and measures to facilitate non-food based biofuels.

Table 5.7 illustrates the current policies of nine Asian countries.⁹ A number of countries have numerical targets for domestic consumption or production of biofuels, including China, Indonesia, Thailand, and Japan. Blending mandates have been introduced or planned in most countries except Singapore and Japan. Thailand and the Republic of Korea experienced opposition from industry when they tried to introduce blending mandates, and government plans were postponed or scaled back. The most commonly used economic incentives are taxes and subsidies. Thailand's policy to lower the taxes on ethanol blended gasoline (gasohol) was especially effective in leading to a large increase in consumption. On the other hand, Indonesia's subsidy structure has not been effective since it is offset by subsidies for fossil fuels. India is the only country in the list that has fixed the purchase price of ethanol and biodiesel.

Some countries have started to address the negative effects of using edible feedstocks for biofuel production. China drastically changed its policy in June 2007 by deciding not to approve any new projects using grain-based ethanol. Japan and Singapore are focusing on developing second generation biofuels. Other countries are investigating and promoting the production of biofuels from alternative feedstocks such as jatropha.

The policies of these selected countries are summarised as follows:

China, the world's third largest ethanol producer, previously promoted corn-based bioethanol. However, in May 2007 it issued a new policy that energy crops should not compete with grain. The government stopped approving new projects using food based ethanol and urged the current facilities to switch to new sources such as sorghum, batata, and cassava (Sun 2007). China plans to meet 15% of transportation energy through biofuels by 2020. The government mandated blending of 10% ethanol as a trial in some regions and provides incentives, such as subsidies and tax exemptions (Global Bioenergy Partnership 2007).

India is promoting bioethanol and biodiesel through phased mandates, fixed prices, and tax incentives. Due to a supply shortage from 2004 to 2005, the ethanol blending mandate was made optional in October 2004, but it resumed in 20 states from October 2006. A nationwide 5% blending mandate for diesel is planned (Global Bioenergy Partnership 2007). To address the fuel versus food issue, the government is considering production of ethanol from sweet sorghum, sugar beet, cassava, and tapioca, and production of biodiesel from non-edible seed bearing trees/shrubs like jatropha (Subramanian 2007). The national government considers the issue of potential food-fuel conflict to be very important, and the delay in announcing the new biofuel

policy (as of February 2008) could be evidence that it is be approaching the biofuel issue cautiously. Some state governments are more active in promoting biofuels. Policy discussion focuses on planting biofuel crops on wastelands throughout the country and integrating production with rural development programs.¹⁰

Malaysia, one of the world's two major producers of palm oil along with Indonesia, is experiencing difficulty in enforcing its biofuel blending mandate (USDA Foreign Agricultural Service 2007d).¹¹ Although Malaysia has issued licenses for 91 biodiesel producers, due to high prices for crude palm oil, only four of them have actually begun operating (Nagarajan 2008). To promote sales, a plan to subsidise prices was announced (Mustapha 2008). The government is also encouraging additional feedstocks including jatropha, nipah, sago and oil palm biomass (Lunjew 2007).

Indonesia is experiencing falling oil production, and its oil exports are falling even faster due to increased domestic consumption, so the government wants to replace some domestic oil consumption with biofuels. It set a target to increase biodiesel use to 2% of its energy mix by 2010 (Legowo 2007). Blending is not mandated, but blending up to 10% is allowed. However, biofuel promotion is facing obstacles. Although the Indonesian state-owned oil firm is selling blended biodiesel, it cut the blend to 2.5% in April 2007 due to rising palm oil prices and continuation of fossil fuel subsidies set at the same level as for biodiesel (Daily Times 2007). NGOs are complaining about the lack of consideration of the impacts caused by Indonesia's expansion of crude palm oil production (Mahr 2007). Indonesia has imposed export taxes on crude palm oil to discourage exports and save it for domestic cooking use, and it has also recently imposed a 2% export tax on biofuels (Leow 2008; Commodity Online 2008).

Thailand, a low-cost sugar producer, plans to replace 20% of its vehicle fuel consumption with biofuels and natural gas within the next five years (Waranusantikule 2008). Tax breaks for 10% ethanol blended gasoline have been used to maintain a consistent price advantage, which has increased consumption 23-fold in 2004 and 11-fold in 2005. After consumption increases stalled, the government took steps to increase the price difference (Kojima et al. 2007). In January 2008, 15 service stations in Bangkok began selling 20% ethanol blended gasoline priced six baht per litre (about USD 0.19) cheaper than premium gasoline (Bangkok Post 2007). However, the government has not been able to fully implement the blending mandate for ethanol due to opposition from the automobile industry (Worldwatch Institute 2007). In contrast, a mandatory blend of 2% palm oil (B2) for diesel vehicles is planned in 2008 (Waranusantikule 2008).

The Philippines is the world's largest exporter of coconut oil, and a 2007 biofuel law mandates a 1% coconut oil blend for diesel and 2% by 2009. This law also requires the addition of at least 5% ethanol in other gasoline products by 2009 and 10% by 2011 (USDA Foreign Agricultural Service 2007e). It provides various tax incentives and financial assistance. The viability of jatropha methyl ester is now being seriously studied, and propagation of jatropha in military camps has been implemented (Marasigan 2007; Laur 2006).

Table 5.7. Biofuel policies in selected Asian countries

Country	Numerical targets	Blending mandate	Economic measures	Policies for second generation biofuels & alternative feedstocks
China	Biofuel share 15% of transportation energy by 2020.	Ethanol: trial period of 10% blending mandates in some regions.	Ethanol: Incentives, subsidies and tax exemption for production. Diesel: Tax exemption for biodiesel from animal fat or vegetable oil.	No new projects of grain-based ethanol to be approved. Experimenting with 2 nd generation fuels.
India	No target identified.	Ethanol: Blending 5% in gasoline in designated states.	Ethanol: Excise duty concession. Ethanol and Diesel: Fixed prices for purchase by marketing companies.	Promotion of jatropha.
Malaysia	No target identified.	Diesel: Blending of 5% palm olein in diesel.	Diesel: Plans to subsidise prices for blended diesel.	Promotion of jatropha, nipa, etc.
Indonesia	Domestic biofuel utilisation; 2% of energy mix by 2010.	Diesel: Blending is not mandatory but blended fuels are being sold (currently 2.5-5%) and there is a plan to increase biodiesel blend to 10% in 2010.	Diesel: Subsidies (at the same level as fossil fuels).	Seriously considering jatropha and cassava.
Thailand	Plan to replace 20% of vehicle fuel consumption with biofuels and natural gas by 2012.	Diesel: 2% palm oil for all diesel vehicles from April 2008.	Ethanol: Price incentives through tax exemptions.	Utilisation of cassava.
Philippines	No target identified.	Ethanol: 5% by 2009, 10% by 2011. Diesel: 1% coconut blend, 2% by 2009.	Ethanol and Diesel: Tax exemptions and priority in financing.	Studies and pilot projects for jatropha.
Republic of Korea	No target identified.	Diesel: 0.5% biodiesel blend to be increased to 3% by 2012.	Biodiesel: Tax exemptions.	Now identifying appropriate energy crops.
Japan	Plan to replace 500 ML/year of transportation petrol with liquid biofuels by 2010.	No blending mandate. Upper limits for blending are 3% for ethanol and 5% for biodiesel.	Ethanol: Subsidies for production. Tax exemptions are being planned.	Promotion of cellulose-based ethanol.
Singapore	No target identified.	No blending mandate identified.	Promoting investment in biodiesel plants.	Plan to focus on second generation biofuels.

Information as of January 2008. Sources: Worldwatch Institute (2007), GBEP (2007), Sun (2007), Kojima et al. (2007), Subramanian (2007), USDA Foreign Agricultural Service (2007a, b, c, d, e, f), Mustapha (2008), Lunjiew (2007), Legowo (2007), Daily Times (2007), Waranusantikul (2008), Marasigan (2007), Ehrlich (2007), Seo (2008), Iijima (2007), Nikkan Kougyou Shimbun (2008), Nihon Keizai Shimbun (2007), Kolesnikov-Jessop (2007).

The Republic of Korea's target is still comparatively low, with a mandate of 0.5% biodiesel in domestic diesel, much lower than the initial goal of a mandatory 5% blend, which was successfully opposed by domestic refiners (Reuters 2007d). A plan to raise the content to 3% by 2012 was announced in September 2007 (Ehrlich 2007). A feasibility study for bioethanol was started in 2006 (USDA Foreign Agricultural Service 2007c).

Japan's Kyoto Protocol Target Achievement Plan aims to replace 500 ML per year of petroleum based transportation fuels with liquid biofuels by 2010.¹² Japan does not have a blending mandate but regulates the maximum blending of ethanol and biodiesel, allowing up to 3% for bioethanol and 5% for biodiesel (Iijima 2007). Bioethanol blended oils started to be sold in 2007. The government plans to introduce exemptions from the gasoline tax and other tax benefits for biofuel crop producers and refiners (Nihon Keizai Shimbun 2007; Nikkan Kougyou Shimbun 2008). The Japanese biomass strategy, revised in 2006, emphasises the importance of cellulosic biofuels, prioritises unutilised resources such as thinned lumber, and promotes "biomass towns" (communities where biomass is totally utilised) (Nihon Keizai Shimbun 2008; Reuters 2007b). Grassroots movements to use waste for biodiesel are also notable in Japan. Municipal governments and NGOs have developed community-based programmes for biodiesel utilising used cooking oil (box 5.3). The annual production of such biodiesel is estimated to be between 4-5 ML per year (Biomass Nippon Strategy Promotion Conference 2007).

Box 5.3 Biodiesel fuel production project in Kyoto

The city of Kyoto started to utilise biodiesel produced from waste cooking oil for 220 garbage collection trucks, just before the meeting of the Conference of the Parties of the UNFCCC in 1997. In 2000, it began to use 20% biodiesel blends for approximately 80 municipal buses. Kyoto has been using 1.5 ML of biodiesel annually, which is estimated to have reduced CO₂ emissions by about 4,000 t/yr. The household waste cooking oil scheme has expanded to the point that there are about a thousand collection points which collect a total of 0.13 ML per year. To ensure the quality of the fuel, a tentative standard called the Kyoto Standard has been developed by a panel of experts. A fuel production facility has been producing 5,000 litres per day since June 2004.

Source: Kyoto City 2007.

The future development of Japan's biofuel policies and markets is very significant. If Japan becomes a large consumer of biofuels, much of it will need to be imported, according to most observers. Thus, Japan's actions will have significant effects on countries that produce biofuels and biofuel feedstocks.

Singapore, the world's third-largest petroleum refining centre, has made efforts to jump-start biodiesel manufacturing on Jurong Island. Its biodiesel production output is expected to exceed 1 Mt/yr by 2010 (Clark 2007b). A field test to examine the feasibility of 5% palm oil methyl esters has been conducted by a group of companies in cooperation with government agencies (Communications DNA Pte Ltd 2007). The government intends to focus on promoting second-generation biofuels (Kolesnikov-Jessop 2007).

4.2. Regional initiatives related to biofuel policies in Asia

Some measures to promote biofuels have been implemented at the international level in Asia. In January 2007, Asian political leaders declared their collective intention to promote biofuels in the Cebu Declaration on East Asian Energy Security at the Second East Asia Summit. One of the measures in the statement was to “encourage the use of biofuels and work towards freer trade on biofuels and a standard on biofuels used in engines and motor vehicles” (East Asia Summit 2007).

In response to growing concerns about potential adverse environmental effects due to expanding biofuel production, various international organizations have started to participate in the development of biofuel sustainability certification schemes, including the European Commission, the Food and Agriculture Organisation of the United Nations, the United Nations Environment Programme, the Global Bioenergy Partnership, and the International Energy Agency (Dam et al. 2008). In Asia, the development of biofuel sustainability certification schemes has been taken up by “roundtables”, which are organizing multi-stakeholder dialogues to help reach a consensus on appropriate criteria (Dam et al. 2008). The “Roundtable on Sustainable Palm Oil” (RSPO) was founded in 2004 as a global multi-stakeholder initiative on sustainable palm oil, with the principal objective “to promote the growth and use of sustainable palm oil through cooperation within the supply chain and open dialogue between its stakeholders.” Members represent major players along the palm oil supply chain, including oil palm growers, palm oil processors and traders, consumer goods manufacturers, retailers, banks and investors, environmental/nature conservation NGOs, and social/development NGOs. Malaysian and Indonesian palm oil associations are among the members (Roundtable on Sustainable Palm Oil 2004; Kojima et al. 2007). A certification protocol was developed and the certification process was launched in November 2007 (RSPO 2007; Reuters 2007c).

The Roundtable on Sustainable Biofuels (RSB), led by EPFL (École Polytechnique Fédérale de Lausanne) Energy Center, is an international multi-stakeholder initiative which aims to develop standards for the sustainability of biofuels; its first stakeholder meeting was held in 2006. Currently the RSB is focused on the development of principles and criteria for sustainable biofuels production, and hopes that the draft standards will be available by mid-2008 (Roundtable on Sustainable Biofuels 2007). Other roundtable initiatives focusing on biofuel feedstocks include the Roundtable on Responsible Soy Association and the Better Sugarcane Initiative.

The “roundtable approach” provides opportunities to develop certification systems supported by a wide range of stakeholders. However, as the criteria developed by those roundtables are only voluntary commitments, this approach will be effective only if all stakeholders actually follow the criteria (Dam et al. 2008; Reuters 2007a). Another concern is the motivation of the participants. Some NGOs, such as Friends of the Earth, argue that the roundtables provide some governments an excuse not to take stronger, more direct measures to protect the environment and vulnerable populations (Reuters 2007a).

4.3. Implications of current biofuel-related policies in Asia

While many biofuel promotion policies of Asian countries are ambitious and well-intentioned, several things are not entirely clear:

(i) *Is it physically possible to implement the biofuel promotion strategies?* There may be insurmountable physical constraints. Land and water availability analysis has not been conducted, and there are doubts about whether there is enough available land in Asia to significantly increase biofuel production, especially without significantly increasing food prices. Countries are already having difficulty meeting biofuel consumption targets, which have been scaled back, and food prices are increasing.

(ii) *Can biofuel promotion strategies be implemented sustainably, i.e., actually reduce GHG emissions without causing other environmental or socioeconomic problems?* All national biofuel strategies declare that biofuels should be produced in a sustainable manner, but current policies do not include concrete mechanisms to ensure this. Even the EU has yet to agree upon sustainability standards, so it may be even more difficult for developing countries with limited capacity to regulate and implement them. Nevertheless, it is an important way to ensure that the benefits to be gained from biofuels will outweigh the costs of their potential negative impacts. Ultimately, sustainability standards must be agreed upon internationally and applied locally. Initiatives such as the RSPO and RSB should be supported by governments and utilised to strengthen their own policies. Currently, membership in the RSPO is voluntary and not yet mandated by law, so even though Malaysia is the prime mover of the RSPO, environmental NGOs are still highly critical about the biodiversity impacts of oil palm plantation expansion in forests because not all palm oil producers are required to follow RSPO best practices.¹³

Focusing on short-term gains simply shifts environmental problems from one sector to another, for example reducing GHG emissions in transport at the expense of clearing forests for biofuel plantations. Unsustainable practices will not only endanger the environment and lead to social problems, but also endanger the biofuel industry itself in the long run. It would be to the advantage of feedstock producing countries, especially developing ones, to set and adopt mandatory sustainability standards for the biofuel industry to follow from the outset. These would be more costly to implement later.

(iii) *Can biofuel promotion policies actually achieve the goal of promoting energy security?* At present, the contribution that first generation biofuels can make to energy security is physically very limited, comes at a considerable financial cost, and could have significant environmental and social costs. Second generation biofuels are much more promising, but they may also be financially costly in the short term. Since biofuel promotion currently requires significant government financial assistance, it would be advisable to ensure that this assistance promotes environmental and social sustainability of biofuel production.

Other observations on current biofuel promotion policies include:

(i) *Insufficient attention to quality standards.* Biofuels are not created equal. The national binding numerical targets and blending mandates are silent on biofuel quality standards. The Asian biofuel industry is in its infancy and production can barely meet domestic demand. For now, the lack of quality standards makes it easier to start up

domestic biofuel industries. In the long run, a lack of standards will hinder development of the market, and could distort competition and trade, and export potential could be damaged.

(ii) *Insufficient attention to second generation biofuels.* Current policies are focused on first generation biofuels. Research on technology to increase productivity and yields will improve their cost benefit profile. But second generation biofuels will replace first generation ones as soon as the technology becomes commercially viable. Feedstock producing countries, including developing ones, should be prepared for this transition.

(iii) *Importance of international cooperation.* Ultimately, the success of national biofuel policies will depend on whether biofuels can be produced sustainably. National policies are not likely to attain this on their own, and international cooperation is important. Moreover, if each country develops its own standards, trade will become difficult. Potential exporting countries—mainly developing countries in Asia—especially may have difficulty finding markets if importing countries do not have confidence that an exporter's biofuels have been sustainably produced. An internationally agreed certification system would provide confidence that the benefits of biofuels in climate change mitigation, energy security and rural development are not being realised at the expense of the environment.

5. Conclusions and recommendations

There is no general consensus regarding the best policies for biofuels. Existing policy recommendations range from rapid promotion to cautious promotion (combined with more research) to a moratorium. Many policy recommendations relating to biofuels come from businesses with an interest in promoting (or restraining) them, or non-Asian NGOs and research institutes. Unfortunately, little serious policy analysis has been conducted by independent organisations in Asia or considering Asian conditions. This chapter concurs with one area of general agreement; waste-to-biofuels or so-called second generation biofuels based on cellulosic biomass have considerably more potential than first generation biofuels and are more consistent with sustainable development principles. Much technical research on second generation biofuels has been done in developed countries, including Japan, but more resources could be devoted to them, and little research has focused on their development in conditions specific to developing countries in Asia.

Nevertheless, it is still important to develop policies to address the issues posed by first generation biofuels, which many Asian countries have already decided to strongly promote. It is still not clear when second generation biofuel technology will be ready for large scale implementation, despite the existence of numerous pilot projects, and the processing technology for first generation biofuels is not easily converted to second generation biofuels.

It appears theoretically possible to produce biofuels sustainably in Asia, as long as the issue of land use change is addressed. In addition, biofuels could contribute to GHG reduction, energy security, and poverty reduction, at least to a limited extent. However, there are strong economic incentives to produce biofuels unsustainably, especially by destroying rainforests and peat lands, and it is unclear to what extent biofuel utilisation targets can be met by sustainable means.

Neither of the policy directions at both ends of the spectrum—a strict moratorium on biofuels on one hand, or accelerated large scale promotion on the other—appears to be necessary or realistic. Many Asian governments are already intent on promoting biofuels but production will not be enough to meet existing utilisation targets anyway. Nevertheless, strengthening targets or promotion measures without building in policy safeguards to ensure that additional biofuels are produced sustainably could lead to significantly accelerated deforestation or other environmental damage.

Therefore, in the near term, the policy priority should be to find ways to promote sustainable production methods for biofuel feedstocks, especially how to avoid direct or indirect deforestation. For some Asian governments, promoting sustainable production of biofuels and environmental protection may not be a high priority, especially compared to energy security and economic development considerations. If governments follow a short-term strategy to promote biofuels in an unsustainable manner, however, the resulting environmental damage, economic disruption, and intensified poverty could ultimately be counterproductive—the cure could be worse than the disease. Developed countries have a special responsibility to ensure that any imported biofuels are produced in a sustainable manner. Addressing domestic climate change commitments by causing environmental or social problems in biofuel producing countries is not acceptable.

Developing a system to certify sustainably produced biofuels may be a good first step to promote their sustainable production. This could be based on sustainability criteria developed through existing multi-stakeholder initiatives like RSB and RSPO. However, since these criteria would be voluntary, implementation may require additional action by governments to make them mandatory. Countries that mainly import biofuels, including advanced countries like Japan, could base domestic standards for biofuels on globally agreed sustainability criteria to promote sustainable production. Still, implementation of sustainability criteria will require international cooperation and independent monitoring to be fully effective. It will also require improved collection of data related to biofuels.

Until there is reasonable assurance that biofuels can be sustainably produced, it would be better to adopt a cautious approach. Likewise, clean development mechanism procedures and criteria for approval of biofuel-related projects should not be relaxed for the same reason. Policy finance or aid should focus on research and development or policies to promote sustainable production methods, especially on second generation biofuels, and not on increased production of first generation biofuels.

It is also important to consider the diversity of conditions (for example level of development, production conditions, consumption conditions, feedstock availability, climate, etc.) in Asia when considering biofuel related policies. The most appropriate policies may be different for each country, or even within countries.

Considerable policy discussion has focused on biofuel trade barriers, most notably the high US tariff on ethanol, and there have been many recommendations to reduce protectionist barriers to biofuel trade, and to consider the classification of biofuels as an environmental good at the World Trade Organisation. Reducing trade barriers will enhance economic efficiency and reduce distortions. For biofuels, however, the first priority is to ensure that they are produced sustainably, and reductions in trade barriers do not address that issue directly, and could even encourage more unsustainable production. Moreover, it will be difficult to agree on classification of biofuels as an

environmental good until there is reasonable confidence that sustainably and unsustainably produced biofuels can be distinguished from each other, possibly through a globally accepted certification system. Therefore, it is not recommended to prioritise trade policy measures yet.

It is also not recommended to use infant industry protection to promote domestic biofuel production and discourage imports, as some developing countries appear to be doing, since it may be counterproductive. Here, there are tradeoffs between the goals of promoting domestic biofuel production, cost reduction, global environmental protection (GHG reduction), and poverty reduction. Infant industry protection would increase the costs of energy, transportation, and food, thereby undermining gains in energy security, and disproportionately harming low income people. Infant industry protection could also encourage more unsustainable production methods (which may be cheaper than sustainable methods). In contrast, prioritisation of GHG emissions reduction could imply promoting imports instead of domestic production, if imported biofuels are more sustainably produced (and possibly cheaper). Domestic production of biofuels may or may not be the best option economically and/or environmentally, and each country's situation should be analysed individually.

Finally, even if first generation biofuels could be produced sustainably and contribute to GHG emissions reduction, the contribution will remain small. Energy conservation and the promotion of other forms of renewable energy remain essential, and biofuels by themselves should not be regarded as a silver bullet. They should not be the exclusive or even the main focus of climate change and energy policy. All countries should place biofuels in the context of a comprehensive energy policy which includes conservation as well as the promotion of other renewable energy forms. Biofuel policies should also be embedded in broader sustainable development considerations, and the economic, social and environmental implications of any new policies should be more carefully assessed.

Future research agenda

Additional research on biofuels is needed in order to effectively inform future policies, especially in the following areas: (i) more comprehensive LCA studies of the environmental effects of biofuels; (ii) economic and social effects of biofuels; and (iii) more cost effective and environmentally friendly ways to produce biofuels, especially second generation ones. Advanced countries are already conducting considerable research, but developing countries should conduct their own research because results on these topics could likely be location specific. For example, each country has different potential feedstocks and production conditions for second generation biofuels.

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Endnotes – Chapter 5

¹ According to the Symposium on Sustainable Consumption, in Oslo, Norway, 1994, “sustainable production and consumption is the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations” (Symposium on Sustainable Consumption. Oslo, Norway; 19-20 January 1994).

² Life cycle assessment refers to a comprehensive assessment of the impacts of a product throughout its life cycle, from production to consumption to disposal (cradle to grave).

³ ETBE is an oxygenated fuel that can increase the combustion efficiency of gasoline and help in better air quality.

⁴ This is because the co-product glycerine is produced in the trans-esterification process.

⁵ Net energy value (NEV) stands for the net energy contained in the biofuel after making necessary corrections for the energy consumed in producing a litre of biofuel.

⁶ This includes the conversion of existing crops from food use to fuel use.

⁷ One litre of biodiesel contains 8.65% lower energy than diesel.

⁸ Unutilised biomass includes non-food parts of agricultural crops and remaining materials in forest land, according to the Biomass Nippon Strategy.

⁹ As of February 2008.

¹⁰ Interviews with Indian government officials, February, 2008.

¹¹ In the European Union, B5 biodiesel blend contains 95% diesel combined with 5% methyl ester, not palm olein.

¹² The Kyoto Protocol Target Achievement Plan (2005) sets a goal of replacing 19.1 billion litres of petroleum oil with “new energy sources” to reduce approximately 46.9 Mt of CO₂. The share of transportation fuels in this target is 2.6%.

¹³ The Roundtable on Sustainable Palm Oil has issued a set of 8 principles based on best practices that are considered to enhance the sustainability of palm oil production.

| CHAPTER 6 |

URBAN ORGANIC WASTE –
FROM HAZARD TO RESOURCE



Chapter 6

Urban Organic Waste – From Hazard to Resource

1. Introduction

Uncollected and improperly treated organic wastes are sanitary hazards and sources of public nuisance in developing countries, especially in densely populated cities. However, organic waste contains plant nutrients and energy, so it is also a potential resource. Local governments typically try to reduce the hazards posed by organising a collection system and depositing the waste in open dumpsites, usually in wasteland on the city outskirts. The people living there, who are usually low-income groups, are exposed to health and environmental impacts, and some of them who make a living by scavenging on the waste dumps, face even greater hazards. In response to these problems, many municipalities try to upgrade their dump sites to landfills, which can mean anything from a marginally improved fenced-off dump to a fully engineered site with gas and liquid effluent (leachate) recovery systems. Upgrading existing dumpsites is a relatively affordable option, which can solve the immediate sanitary hazards and reduce leakage of environmental pollutants. In the long term, however, delivering untreated household waste to landfills is not a sustainable solution. The availability of suitable landfill sites is highly limited in most regions and land is needed for other purposes. Potentially valuable resources are lost when buried in landfills; surrounding soil, plants, surface and underground waters may be contaminated by substances leaching from the site and the degradation of organic materials generates methane, a powerful greenhouse gas (GHG). At the international level, the significance of the waste sector for climate protection is being increasingly recognised (IPCC 2007).

This chapter deals with the linkages between organic waste treatment and climate change in cities in developing countries in the Asia-Pacific region, and it attempts to identify policies that can satisfy both sustainable development and climate protection objectives. It focuses on biodegradable waste, mainly food and yard waste, from households, institutions and small businesses, and how methane emissions from the treatment of this waste can be avoided (or captured and used). It concludes that composting is one method that can reduce GHG emissions from waste treatment and seems to have potential in the region. Therefore, the chapter examines the record of introducing and promoting composting in cities in developing countries in Asia-Pacific. Special attention is given to how policymakers at national and local levels can facilitate composting initiatives. This analysis is based on a literature review of policies relevant to organic waste management in the major developing countries in the region and six local case studies based on literature sources, site visits and interviews.

2. Greenhouse gas emissions from waste treatment

Decomposition of organic waste under anaerobic conditions in solid waste disposal sites (SWDS) leads to the formation of biogas consisting of approximately 50% methane (IPCC 2006). Methane is a potent GHG with a radiative forcing 25 times higher than CO₂, and among the anthropogenic emissions it is the second largest contributor to global warming after CO₂ (IPCC 2007). The CO₂ emitted from the treatment of organic waste is regarded as part of the biological carbon cycle and is therefore normally not included in calculations of anthropogenic GHG emissions.

Methane produced at SWDS contributes approximately 3-4% to the global anthropogenic GHG emissions (IPCC 2006). Although there are other sectors generating more GHG emissions, the emissions from waste are already significant and expected to increase further due to economic growth and changing consumption patterns in developing countries. This section includes a calculation of GHG emissions from waste management in developing countries in Asia-Pacific based on World Bank estimates of waste generation between 1995 and 2025. A calculation based on more recent data for 2000 is also presented.

2.1. Methane emissions between 1995 and 2025

Methane generation in SWDS depends on (i) the total amount of solid waste, which is determined by population size and affluence; (ii) composition of the waste; and (iii) the characteristics of the SWDS (e.g. climate, size/depth, pH level, and moisture). Growing populations, increased incomes, and expanding industrialisation are expected to lead to increasing amounts of solid waste and potentially escalate methane emissions from SWDS (Bogner et al. 2007; USEPA 2006).

A World Bank study (Hoornweg et al. 1999) estimated that urban per capita waste generation rates will increase by 1.14 to 1.73 times in the selected countries between 1995 and 2025. The same report also predicted significant changes in waste composition patterns by 2025. Sharp increases in waste generation and changes in waste composition will place enormous stress on limited financial resources and inadequate waste management systems. Increased waste volumes will also result in increased methane emissions if current trends in waste treatment technologies continue.

Table 6.1. Waste generation rates and methane emissions from solid waste disposal sites (1995-2025)

Country	1995 data			2025 projection		
	Urban MSW generation rate (kg/cap/day)*	Methane emissions (kt/year)	Methane emissions (kg/cap/year)	Urban MSW generation rate (kg/cap/day)*	Estimated methane emissions (kt/year)	Estimated methane emissions (kg/cap/year)
China	0.79	898.52	2.35	0.90	4,075.12	4.93
India	0.46	474.55	1.92	0.70	2,774.92	5.37
Indonesia	0.76	457.49	6.52	1.00	1,581.74	9.05
Thailand	1.10	165.33	9.44	1.50	424.39	13.58
The Philippines	0.52	127.83	3.46	0.80	451.11	5.61
Malaysia	0.81	68.91	6.08	1.40	281.11	11.09
Bangladesh	0.49	38.66	1.46	0.60	243.69	3.29
Vietnam	0.55	31.76	1.96	0.70	189.87	4.60
Myanmar	0.45	18.46	1.61	0.60	106.41	3.94
Cambodia	0.69	2.67	1.64	0.80	25.50	3.50
Lao PDR	0.69	1.33	1.64	0.80	10.41	3.50

* Data on urban MSW generation rate are cited from Hoornweg et al. 1999; MSW=municipal solid waste

Emissions of methane between 1995 and 2025 were calculated using the mass-balance methodology from the Intergovernmental Panel on Climate Change (IPCC) guidelines (IPCC 1997). Methane emissions from the selected countries are projected to increase sharply (2.6 to 9.6 times) until 2025 (table 6.1).

The projected per-capita methane emissions would increase 1.4 to 2.8 times the 1995 levels. On average, a doubling of these emissions was estimated. In addition, according to projections from the United Nations (UN) Population Division, the urban populations of the countries studied are expected to increase 1.8 to 4.5 times. From these projections, it is clear that GHG emissions from waste disposal are growing rapidly and will become increasingly important.

In 1995, methane emissions per capita were higher in Thailand, Indonesia and Malaysia than in other countries: 9.4, 6.5, and 6.1 kg per capita per day, respectively. In 2025, due to economic growth and expanding urbanisation, Malaysia would become the second highest methane emitter per capita among the selected countries.

2.2. Methane emissions in 2000

Considering the rapid economic growth of most of the target countries, and the uncertainty of the basic waste data, emissions were recalculated using more recent data. To calculate each country's amount of solid waste generated, country specific per-capita waste generation rates were compiled from various literature sources. The amount of municipal solid waste in each country was then calculated based on country specific per-capita waste generation rates and urban population data for the year 2000 (from UN statistics). For other parameters, default values from the 2006 IPCC guidelines were used (IPCC 2006).

Table 6.2. Methane emissions from MSW in selected countries in 2000

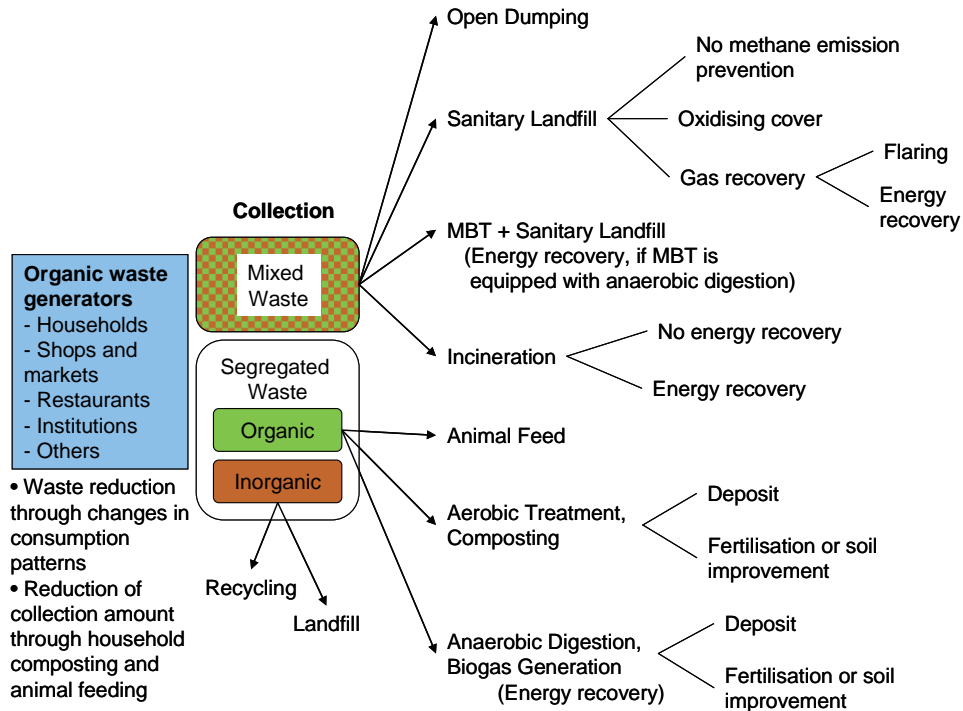
Country	MSW generation rate (kg/cap/day)	Urban population (thousands)	Fraction disposed to SWDSs	Estimated Methane emissions (kt/year)	Methane emissions (kg/cap/year)
China	1.00	456,247	0.50	2,281	5.00
India	0.47	281,255	0.70	1,121	3.98
Indonesia	0.77	88,863	0.80	663	7.46
Thailand	1.10	18,974	0.80	176	9.26
The Philippines	0.52	44,327	0.62	173	3.90
Malaysia	0.82	14,212	0.70	98.8	6.95
Bangladesh	0.49	31,996	0.50	94.9	2.97
Vietnam	0.70	19,006	0.60	96.7	5.09
Myanmar	0.44	13,290	0.60	42.5	3.20
Cambodia	0.76	2,223	0.40	8.18	3.68
Lao PDR	0.75	1,018	0.40	3.70	3.63

Total emissions in the waste sector are driven primarily by urban population size. As expected, the highest emissions occur in the most populous countries, China and India (table 6.2). These countries are also among the top five global emitters of total GHGs (Baumert et al. 2005). In 2000, emissions from the waste sector in selected countries were already 1.1 to 3.1 times higher than estimated for 1995. According to this calculation, methane emissions per capita in 2000 in China, Vietnam, Cambodia and Lao PDR already exceeded projected values for 2025. If current trends continue, a drastic increase in emissions can be expected.

3. Organic waste treatment

Open dumping and simple landfills are the most common treatment methods for municipal solid waste in developing countries. The main reason is the low investment and operation costs. However, the environmental problems related to these treatment techniques are well known and, as mentioned in the introduction, many municipalities and communities are trying to introduce improved methods. Paradoxically, upgrading open dumps to landfills may contribute to increased emissions of GHG. Methane generation is higher in deep, compacted landfills than in shallow, loosely packed open dumps because of the anaerobic conditions prevailing in the former. Hence, by introducing measures aimed at improving waste management, local authorities run the risk of shifting local problems related to health impacts, water pollution, odour and land shortage to the global problem of climate change. However, a number of alternative treatment methods exist (fig. 6.1) and more experience in using these methods is gradually being gained. This section briefly presents the main treatment methods and discusses their pros and cons from a sustainability perspective with special attention given to emissions of GHGs.

Figure 6.1. Treatment methods for municipal organic waste



Note: MBT stands for mechanical-biological treatment.

3.1. Waste reduction

Waste reduction is the most fundamental strategy for sustainable waste management, and all waste management plans should include efforts to reduce the amount of waste generated. Waste reduction has the double benefit of saving resources and reducing costs for waste collection and treatment. In developed countries, the significance of waste reduction is now well recognised (e.g. OECD 2000). In most developing countries, where per-capita waste generation is still at relatively low levels, there is less scope for reduction, but also in these countries – especially in urban areas – there are growing numbers of people who generate as much waste as people in industrialised countries. Significant waste reduction takes time to achieve and requires large numbers of households to change their consumption patterns and daily habits.

From the perspective of a municipality responsible for waste collection and treatment, households composting for their own use and feeding of domestic animals can be considered as waste reduction methods. However, in this overview, they are discussed together with other biological treatment methods.

3.2. Improved landfill-based methods

3.2.1. Landfill gas treatment

Recovery of landfill gas has been practiced since the 1970s and globally there are more than 1,100 systems installed (Willumsen 2003). Typically a closed landfill cell (section of a landfill site) is covered and the gas produced in the cell is collected through a system of pipes. The gas collected can either be flared or used as fuel. If the gas replaces fossil fuels, then gas recovery has an additional climate benefit.

In well-designed systems in developed countries, recovery rates of around 90% have been achieved. However, high recovery rates are only expected for landfills designed for gas recovery, equipped with proper cover layers and where tight pipe grids are used for gas collection. In developing countries recovery rates are typically much lower, with up to 60% leakage expected (Hoorweg et al. 1999). The guidelines for clean development mechanism (CDM) projects recommend that a recovery rate of 50% be used in project proposals. Hence, from a climate protection perspective, landfills with gas recovery systems are not entirely suitable for treating organic waste.

Methane emissions from landfills can also be reduced by using oxidising cover layers. Such layers need to be kept well-aerated so that methanotrophic bacteria, which can only be active under aerobic conditions, can decompose the methane. The efficiency of oxidising layers is sensitive to layer thickness, layer substrate, temperature and humidity, but removal efficiencies up to 75% have been reported (Chiemchaisri 2008).

An alternative approach is to reduce methane generation through aeration of the whole landfill. By installing a piping system and pumping air into the landfill cells, it is possible to reduce the prevalence of anaerobic conditions and thereby also methane generation.

3.2.2. Mechanical biological treatment

Mechanical-biological treatment (MBT) is a group of hybrid methods where unsorted waste undergoes pre-treatment before disposal in landfills. There are many possible designs, but a common MBT pre-treatment system includes (i) mechanical separation where recyclable materials such as ferrous metals and plastics are removed; and (ii) biological treatment where the organic fraction is partly degraded. The biological step can include both anaerobic and aerobic treatment, generating biogas which can be recovered. MBT can reduce the volume of the waste by up to 40% and lower the leakage and gas emissions from landfills significantly (Visvanathan et al. 2005). If the treated waste contains low levels of pollutants, it can be used for landscaping instead of being deposited in a landfill, but not for food production.

Several MBT systems are in operation, mainly in Europe. In China and Thailand; some MBT systems have been installed through financial and technical assistance from Germany. In most of these cases, the technology is simplified with more manual separation and only aerobic treatment. At present it is difficult to assess the potential of this method for developing countries.

3.3. Thermal and biological treatment methods

3.3.1. Incineration

Incineration of municipal solid waste is widespread in industrialised countries and currently more than 600 facilities are in operation worldwide. Incineration has a number of advantages, which can explain its widespread use (Bogner et al. 2007). It effectively eliminates the hygienic hazards of organic waste and decreases the waste volumes drastically. Methane generation is completely avoided and the process can also generate electricity and heat which can replace energy from fossil fuels.

However, few developing countries are successfully incinerating municipal waste. Waste in developing countries typically has a low calorific content compared to developed countries. The waste is often relatively wet, especially in the tropics, and extra fuel, typically coal, may have to be added (Solenthaler and Bunge 2005). As a consequence, the recoverable energy is low and the cost high. The investment costs for incineration plants are high compared to other options, and the technology used is advanced. In many cities, incineration has met strong opposition because of emission of highly toxic dioxins and other pollutants. It is possible to reduce these emissions to very low levels by advanced flue gas treatment, but this makes the investment costs for incineration plants significantly higher.

3.3.2. Composting

Composting is an aerobic process where micro-organisms decompose organic materials under controlled conditions. The process reduces the waste volume to about one third. Composting can be applied at various scales, from individual households up to large centralised facilities with capacity for several hundred tonnes of waste per day. A number of composting techniques exist; some are manually operated while others aerate the decomposing waste mechanically; some rely on micro-organisms that exist naturally, while others add worms (vermicomposting) or specialised microbes to speed up the process. The residual product is pathogen free and it can be used for improving soil structure and for adding nutrients to soil. Almost all types of soil can benefit from adding compost, especially sandy and clayey soils, which contain little organic matter. In arid regions, compost helps to improve the water holding capacity of the soil. Composting can be a resource for urban and peri-urban agriculture and generate income for urban households (or municipal governments) if farmers are prepared to pay for the compost. Composting has been practiced for a long time in rural areas, and it is therefore not a new and untried method. However, there are some risks and disadvantages of composting; bad smells can occur and vector-borne diseases can spread if the composting process is poorly managed. In general, composting is technically uncomplicated and may be an economically realistic alternative to using landfills for many municipalities in developing Asia.

Under ideal conditions, composting does not generate methane, but under real conditions there is a risk of some emissions caused by anaerobic decomposition. This risk is high if the composting process is poorly managed, especially if the substrate is not sufficiently aerated or becomes too wet. Small emissions of nitrous oxide (N₂O) may occur, but studies have shown that the amounts are small and negligible compared to the emissions saved through avoided landfill gas generation. Recent research has shown that certain types of vermicomposting can generate significant

amounts of N₂O (Hobson et al. 2005). These initial findings indicate a need for more research to be conducted before any sound recommendations on vermicomposting can be given. Since the amount of emissions from composting depends on the specific composting method used and on how well the process is managed, it is not possible to give a definitive answer to the question of how much composting contributes to climate change. Most studies on emissions from composting have been carried out in developed countries where conditions differ from the target countries of this study. Nevertheless several environmental agencies have concluded that when composting is done properly, it generates very small amounts of GHGs (e.g. MFE 2002).

3.3.3. Anaerobic digestion

Anaerobic digestion has been used for many years for the treatment of agricultural waste, organic industrial waste and sewage sludge, but only in recent years has it been used for municipal waste. The process used is basically the same as in a compacted landfill—micro-organisms decompose the organic matter in an oxygen-free environment and generate gas with a high proportion of methane. The process takes place in a closed tank and the gas is collected. Anaerobic digestion generates fewer odours than composting and a digester requires less space than a composting facility with similar capacity. The gas can be used for energy generation, replace fossil fuels, and the residue can be treated in an aerobic process and used as fertiliser. In theory, anaerobic digestion has many advantages and there are several systems in operation, although mainly in industrialised countries.

Under real conditions some leakage of methane from digestion tanks and gas powered combustion engines cannot be avoided. A study in the United Kingdom found emissions from digesters at farms in the range of 3.4 to 8.4%, and a Danish study estimated fugitive losses in gas powered engines at 3.5% on average (Reeh and Møller no date). However, it is reasonable to assume that in developing countries average losses will be higher and in individual cases may be considerably higher.

3.3.4. Animal feed

The use of food waste as animal feed has been practised for as long as humans have kept domestic animals. In rural areas this is still common, but in large cities the demand is usually very limited. There are examples in China, Cambodia and Thailand where food waste is collected for animal feed on a relatively large scale, but in general this option can only be expected to play a minor role in organic waste management.

3.4. Evaluation of organic waste treatment options

Generally disposal of organic waste in landfills without pre-treatment or gas control is undesirable from a sustainability perspective and therefore should be avoided. Landfill gas recovery and the use of oxidising landfill covers have important roles to play for reducing future GHG emissions from old landfills and landfills that are currently in operation. However, municipalities considering constructing new landfills for untreated organic waste, even if equipped with gas recovery systems, should consider that (i) GHG emissions will still be relatively high; (ii) valuable nutrients will be lost or mixed with pollutants; (iii) the land could be used more productively for other purposes; and (iv) the risk of water contamination cannot be eliminated.

Incineration is too costly or unfeasible for many cities in developing countries, and cannot be regarded as the main option for waste treatment in the region. However, in some of the newly industrialised countries, if there is public support for the method, incineration is expected to play an important role. MBT should mainly be regarded as a pre-treatment method, which can reduce some of the problems related with landfills.

From a sustainability perspective, the biological treatment methods (composting and anaerobic digestion) have considerable advantages. They can drastically reduce the emissions of GHGs, recycle nutrients and be introduced on a small scale at low cost. Studies reported in the literature do not agree on which of these methods is the least costly, but they are both much less expensive than incineration. Anaerobic digestion is technically more complicated than composting and to function well the process needs to be operated by professional staff. Composting can be labour intensive and therefore generate more jobs. Low investment requirements make composting especially suitable for projects with limited funding. Together with its low-tech nature and the possibility to introduce it at a very small scale, composting is a highly suitable option for community-driven waste management initiatives. A recent study by Barton et al. (2008) came to the same conclusion and identified composting as the first option to consider when replacing open dumping in developing countries.

For these reasons, the rest of this chapter concentrates on composting, and how national and local policies can support composting initiatives for improved waste management with climate protection benefits. However, this does not imply that composting is regarded as the best treatment option for all kinds of organic waste in all cities. Usage of generated compost in food production requires effective prevention of contamination and this is not possible for all waste streams. Even so, composting can play an important role in many cities—especially cities with large slum areas where living conditions are blighted by uncollected rotting waste and where the municipality has limited capacity to collect and treat the waste properly.

The treatment methods described above are not necessarily competing options. Based on local conditions, municipalities and other local actors need to combine options into an integrated system that can realise the synergies of different methods. Factors such as the amount and composition of waste, the economic conditions, past experience with various treatment methods, households' willingness to segregate their waste at source, the availability of nongovernmental organisations (NGO) or community groups with waste issues on their agendas, land availability, and the demand for organic fertilisers influence which methods can be successful. Typically the best system will be based on a mix of treatment methods, and all systems have to be adapted over time in response to changing conditions.

4. Composting of municipal solid waste

This section investigates urban composting in developing Asian countries and looks at policies to promote composting in the region. First, it describes the current situation regarding carbon financing of projects in the waste sector in Asia. Second, it presents an overview of national policies related to organic waste management and briefly describes the current composting situation in five developing Asian countries. The countries included are those with the largest calculated GHG emissions from the waste

sector (table 6.2). Next, six local cases where composting is playing an important role are described and analysed. Finally, based on the national overviews and the analysis of local experience, improvements in national and municipal policies to support urban composting are suggested.

4.1. Climate policies and the waste sector

At present, climate change concerns do not have a major influence on decisions concerning municipal waste management in the cities of developing Asian countries. Other factors such as public health and costs are given priority. However, within the next few years developing countries in Asia, like all other countries, will have to face the dangers of climate change and take action to limit their emissions. This will require action by all relevant sectors of society, including waste treatment. Thus, there are good reasons to investigate how national policymakers can stimulate municipalities, communities and other local actors to develop more sustainable waste management systems with a low impact on the climate.

One of the linkages between climate policies and the waste sector is CDM under the Kyoto Protocol. CDM projects make it possible for developed countries to fulfil some of the emission reductions mandated by the Kyoto Protocol through climate protection projects in developing countries. CDM projects are awarded certified emission reductions (CER) in proportion to the amount of GHG emissions they can reduce. The CERs can be sold and generate income for further modernisation of the waste disposal systems. In 2007, the average price of CERs was reported to be \$10.90 per tonne of carbon dioxide equivalent (tCO₂e) (Cooper and Ambrosi 2007).

As of the end of February 2008, 948 CDM projects were registered globally and 558 of these were located in Asia. For the waste sector, 256 projects were registered globally, but only 63 projects in Asia; or 24.6%. The most active Asian countries are Malaysia (18 projects), India (13), the Philippines (12) and China (10) (CDM Project Activities Database 2008).

The most common kind of CDM project related with municipal solid waste is landfill gas recovery, but recently a methodology for calculating CERs for composting projects has been developed and the first CDM project on urban composting was registered in Dhaka, Bangladesh, in 2006. The composting experience in Dhaka is described in section 4.3.2 below. Since then, CDM composting projects in China and India have also been registered. In principle, any composting facility above a certain size could qualify for CDM provided that the project can present credible baseline data. However, it can be concluded that CDM financing is a relatively new opportunity which seems to be underutilised at present.

To provide a rough estimate of the economic value of the GHG emissions from the waste sector in each country, the average value of the CERs was applied to estimated methane emissions (table 6.3). The results show that if it were possible for all methane emissions to be avoided and converted into CERs, the annual revenue would be over \$400 million. To put these potential revenues into perspective, compared to the estimated total annual expenditure for waste management in each country¹, the range is 13-60%. This is likely to be an overestimation, however, since per capita spending on waste management is lower in smaller cities and towns. Although the results should be viewed with great caution, they indicate that the potential revenues from carbon financing are significant when compared with the current expenditures.

Table 6.3. Economic value of GHG emissions from landfills compared with municipal solid waste expenditure in selected countries

Countries	Methane emission (thousand tonnes/ year)	CO ₂ emission equivalent (thousand tonnes/year)	Potential revenue (\$'million)	MSW expenditure (\$'million /year)	Potential revenue divided by MSW expenditure (%)
India	1,121	28,025	305	506	60
Bangladesh	949	2,373	25.8	46.7	55
The Philippines	173	4,325	47.1	177	27
Malaysia	98.8	2,470	26.9	213	13
Vietnam	96.7	2,417	26.3	66.5	40

4.2. National waste policies and composting

4.2.1. China

MSW management in China is mainly regulated by the Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste. This law sets a target to fully and rationally utilise solid wastes (FAOLEX 2004). The Technical Policies for Municipal Refuse Disposal and the Prevention and Control of Pollution of 2000 identifies landfills as the first MSW treatment option, to be used where land is available, and incineration as the main alternative. However, the Technical Policies also state that “[a]ppropriate biological disposal technology shall be actively developed...” and it contains a separate section on how composting should be carried out (SEPA 2000). The current ratio of landfills is more than 85% of the total, and only a few landfills are equipped with gas recovery systems (Wiaofei 2008). It appears that biological treatment is primarily regarded as a supplement to the two main methods of landfill and incineration. In China, there are also a number of other laws relevant to waste management. A World Bank study (2005) concluded that the legal system on solid waste is complicated and it includes both overlaps and areas where no agency is responsible.

According to Huang et al. (2006), approximately 7% of the MSW generated in 2002 was composted but this figure is considerably higher than the 4.8% officially reported to the UN in 2003 (UN Statistics 2007). Xiaofei (2008) reported that composting is on a downward trend and that the treatment capacity decreased from 8.8% in 2001 to 4.3% in 2005 mainly due to inferior quality of compost and unfavourable market conditions. A number of cities operate relatively low technology in-vessel composting systems with some success, but many facilities using large-scale technology have faced technical problems and have been shut down. The compost quality of such facilities has typically been low because mixed wastes containing metals, ash, plastics and glass have been composted. Such inferior quality compost can be used only for limited applications (World Bank 2005) and the production cost of compost has been reported to often exceed the market value (Rissanen and Naarajärvi 2004). Initiatives on composting seem to come mostly from the local governments. Compared with other countries, community groups and NGOs seem to play a minor role in waste management, perhaps with the exception of waste pickers (World Bank 2005).

4.2.2. India

India's MSW (Management and Handling) Rules of 2000 clearly stipulate that the amount of waste disposed to landfills must be minimised. The rules further state that: "[t]he biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing..." (MOEF 2000) Specific instructions on composting and quality standards for compost are also included. However, by 2004, few municipalities had started to follow the new rules (Gupta 2004). To expand composting activity, an Inter-Ministerial Task Force on Integrated Plant Nutrient Management has recommended building 1,000 composting plants all over the country and has allocated over \$200 million for this purpose (Gopal 2006). However, it is difficult to make composting financially viable since the Government also provides subsidies for chemical fertilisers (Zürbrugg et al. 2004).

In 1997, it was estimated that around 10% of India's MSW was treated by composting (SOE Asia 2000). However, since this estimate is over 10 years old, it may not be relevant to the current situation. In Delhi, the most densely populated city, it has recently been reported that 9% of the collected municipal solid waste is composted (Talyan et al 2007). There are a large number of centralised composting facilities all over India, typically with capacities of 100-700 tonnes per day (t/d). Most of these facilities are operated by private companies on contracts from the municipal authorities and treat only waste from food markets. However, there are also many cases where centralised composting projects have failed and the facilities have been shut down. A common problem for such facilities has been difficulties in marketing the products.

Since the 1990s, small manually operated composting plants at the community level have been initiated by citizens' initiatives and NGOs. This practice has spread to many major cities including Bangalore, Chennai, Pune and Mumbai (Zürbrugg et al. 2004). For Mumbai, it has been reported that community composting has reduced the municipality's costs for waste treatment (Sarika 2005).

The high price of land is a problem for most urban composting initiatives, but in many cases municipalities provide land for free or at a moderate rent. This is common both for initiatives run by community groups and by private entrepreneurs (Ali 2004). Another common obstacle is the difficulty in borrowing money for investments in composting plants. Banks regard waste treatment initiatives as high-risk projects and demand high interest rates or are unwilling to provide loans (ibid.).

4.2.3. Indonesia

In 1999, Indonesia decentralised responsibility for many urban services to the local authorities. The role of the central government became mainly to provide guidance and technical assistance to the local level. However, local governments have limited financial capacity and do not have sufficient technical and managerial skills to plan, develop and operate effective MSW collection and treatment systems (Sanitation Country Profile 2004). Since 2004 the Government has been preparing an umbrella law to improve its regulation of local MSW management, but this is still only at the drafting stage (WALHI 2007).

Waste management is recognised as a major problem in cities in Indonesia and it has caused several conflicts. Some NGOs are very active on waste issues and attempts to construct new dump sites or incinerators have often been met with strong resistance.

In 2000, it was reported that 1.6% of the solid waste generated in urban areas was composted (Sanitation Country Profile 2004). Decentralised composting is promoted by several NGOs in a number of cities, including the capital, Jakarta (Pasang et al. 2007).

4.2.4. Thailand

In Thailand, four major laws on MSW management have been passed since 1992, but composting is not specifically mentioned in any of them. In 1998, however, the Ministry of Industry identified composting as an alternative waste disposal method for industrial waste (MOI 1998) and in 2005 the Ministry of Agriculture and Cooperatives strengthened its quality standards for compost and bio-fertilisers.

One factor motivating composting in Thailand is the national strategy to develop an export-oriented agro-food industry with a healthy image. Therefore, a number of composting projects are driven by the Ministry of Natural Resources and Environment and additional projects are currently being proposed by authorities at provincial, district and sub-district levels. Furthermore, research on improved household composting methods is currently being undertaken at several Thai universities (Thaipost 2004; Tripetchkul and Chairasert 2003).

To save energy and promote alternative energy production, in 2007 the Ministry of Energy and the Ministry of Interior signed a memorandum of understanding to cooperate on energy and MSW management. The two ministries have set a target that generated organic waste shall be used beneficially through the promotion of fuel production, composting for fertiliser, and production of fish feed (OPT 2007).

4.2.5. The Philippines

In 2000, the Philippines passed its Ecological Solid Waste Management Act, which stresses the need for waste reduction, segregation at source and recycling. Incineration of MSW is explicitly prohibited according to the Clean Air Act of 1999. The Ecological Solid Waste Management Act emphasises the role of composting and requires the barangays, which are the smallest local government units in the Philippines, to develop ecological solid waste management programs, and to establish Materials Recovery Facilities (NSWMC 2000).

However, implementation of the Act has been difficult and in 2007 only 1,714 facilities had been established by about 4% of the barangays (Ecowaste Coalition 2007). Disregard for regulations and laws, lack of political will, insufficient funds, lengthy and bureaucratic procedures, inadequate technical capacity, insufficient number or inappropriate collection vehicles, and an inability to reach out to households have been identified as some of the main implementation problems (Globe-Net 2007). Sapuay (2006) pointed out that the Act is more focused on technical details than on how to create incentives for change and that the penalties for violating the law are so low that many local actors choose to risk the penalty rather than improve the MSW system. In addition, Chiu (no date) noted that the Solid Waste Management Fund required by the Act has not been established.

In 1997, it was estimated that 10% of the MSW was composted (SOE Asia 2000), but there are no recent estimates available. Where composting has been successful it seems mostly to have been activities initiated by NGOs or community groups, or in some cases by the local governments or barangays. There is a growing market for

organic food in the Philippines, and the Department of Agriculture is promoting the use of organic fertilisers. Even so, it has been reported that many composting initiatives have difficulties finding a market for their product (Chiu no date).

4.2.6. Analysis and policy recommendations

The most striking observation is that the two largest countries in the region have set very different priorities in their national waste policies. China regards landfills as the main treatment option, while India strongly avoids them. The Chinese policies also support incineration, an option that is prohibited by law in the Philippines.

All countries have composting systems in operation in several cities, but currently only a minor share (10% or less) of the MSW is composted. However, reliable statistics are lacking and the reported figures are uncertain. Compared with some European countries, the composting share of waste treatment is low, even though the MSW in developing Asia contains more organic matter, and therefore is more suitable for composting.

Both India and the Philippines have advanced legislation on MSW treatment that emphasises the need for waste reduction, segregation at source and biological treatment. The national policies and strategies of China and Thailand also stress these elements of waste management, although not to the same degree. However, all of the countries seem to share a lack of capacity to enforce the laws in order to meet the objectives. The laws require local actors to reform their solid waste management systems to meet high environmental standards, but local governments generally lack the necessary financial capacity and technical knowledge. There are few initiatives from central governments to help local actors meet the requirements stated in the laws.

Composting concerns several governmental departments and there is a clear need for effective coordination. Waste regulation is typically handled by the Ministry of Environment, but sustainable composting, where the product is used for soil improvement, needs support also from other government bodies such as the Ministry of Agriculture. To expand composting it is important not only to stimulate the production of compost but also to promote increased use among farmers. An inter-ministerial body may be needed to coordinate supply oriented and demand oriented policies.

Subsidies to mineral fertilisers are a particular obstacle to increased use of compost and other organic fertilisers. If governments want to promote the beneficial use of compost, these subsidies must be reduced or extended to cover organic fertilisers. Other forms of financial support from national governments could include tax reductions or exemptions for compost and composting equipment.

The demand for organic food is growing, both in the countries studied and in their export markets. This creates an increasing demand for organic fertilisers such as compost. However, despite this trend, many composting initiatives face difficulties in finding markets for their products. The producers of compost and the potential buyers seem to have difficulty in finding each other. Here, national governments can play a role in improving the compost market by reducing transaction costs. Official quality standards for various grades of compost, quality control systems and labelling schemes can be important policy tools. Avoiding contamination of compost is a prerequisite for its sale and safe usage, and experience shows that this requires careful segregation at source. Efforts to develop partnerships between composting initiatives

and fertiliser companies can also be effective. Since many composting initiatives are operating on a small-scale, they typically have very limited capacity to search for potential buyers. Likewise, many organic farmers have difficulties in finding reliable suppliers of fertilisers. Especially for such small and medium-sized actors, databases where buyers and sellers can get in contact can be helpful. Farmers' associations and networks of composting initiatives can play an important role as information brokers and governments can encourage them to become more active in this respect.

Composting activities can be initiated by various actors. Although it is usually the local governments that are formally responsible for waste management, in some countries it is more common to find composting schemes run by NGOs or community groups than by the government. To facilitate such initiatives, local governments need to develop their waste management plans in dialogue with citizens. Therefore, stakeholder involvement in local waste management planning should be required in the national waste legislation.

4.3. Composting in municipal waste management – six case studies

The six cases presented below illustrate different approaches to composting, including community-driven activities and projects initiated by the local government, household composting and centralised systems. The cases also represent different types of cities or towns; Bangkok and Dhaka are national capitals and mega-cities, Nonthaburi and Surabaya are large cities, while Phitsanulok and San Fernando are both small towns. The composting initiatives in Dhaka and Surabaya have gained international recognition as good examples, while San Fernando in the Philippines is a less well known case with an interesting model for cooperation between the local government and community groups. The three cases from Thailand – Bangkok, Nonthaburi and Phitsanulok – represent different types of cities and show varying degrees of success in promoting composting. Each case study includes a short background, identifies the main actors and their roles, describes the main characteristics of the composting scheme, and presents some lessons that other cities can learn from. Table 6.4 provides an overview of the six cases.

4.3.1. Bangkok

Bangkok has a permanent population of around 5.5 million and a population density of over 3,600 persons/km². Waste generation is about 8,369 t/d, which equates to 1.5 kg/capita/day. Bangkok has tried household composting but currently collective composting carried out by a private company is the main activity.

The Bangkok Metropolitan Administration (BMA) promoted household production of liquid fertiliser from food waste in a campaign from 1999-2002 (BMA 2005). Households were provided with effective micro-organisms to stimulate the waste decomposition. This method is quick and the whole process takes only a few weeks. The liquid product can be applied as organic fertiliser or used as a deodoriser in restrooms for example. BMA is no longer supporting this activity and the current scale of household composting is unknown. Recently, interest in household composting has been revived and a project assisted from Kitakyushu City, Japan, which builds on experience from Surabaya is ongoing (Baitragul 2007).

Table 6.4. Comparison of the local case study composting initiatives

Location	Bangkok, Thailand	Dhaka, Bangladesh	Nonthaburi, Thailand	Surabaya, Indonesia	Phtsanulok, Thailand	San Fernando, The Philippines
Composting initiator	Metropolitan Administration	NGO	Municipality	NGO	Municipality	City/Community Council (Barangay)
Main implementing stakeholder	City government and a contracted private company	NGO	City government	NGO, City government and housewives	City government	City government
International cooperation	Japan	UNDP and UNESCAP	EU: Asia Urbs project	Japan	Germany	None
Waste source	Households and organisations generating large volumes of waste	Households and markets	Markets	Households and markets	Households	Households
Quantity of organic waste composted (ton/day)	1,000	13-14	0.6	>40	No data, small quantity	~ 1
Incentive/subsidy	Basket	Government provided land free of charge	None	Basket distribution based on income	Compost box and marketing support in the early stage	City government provided shredder and purchased the compost produced
Composting scale	- Household scale - Centralised large scale	Community	Centralised small scale	Household and community	Household	Community
Composting technique	- A newly developed windrow method - In-vessel composting	A newly developed windrow method	Bio-cell	A newly developed windrow method	Windrow: bamboo and cement boxes	- Drum-composting - Vermicomposting
Compost market & use of product	- Household use - Sale to farmers by company	Sale by the NGO to a fertiliser producer	Sale to farmers by the municipality	- Household use - Sale to market - Used by City government	Household use and sale to market	Use for landscaping projects and nurseries by the City government

In addition to household composting, BMA has also developed a system for centralised composting. Since early 2005, the city collects sorted organic waste from selected target sources including education institutions, department stores, hotels, markets, hospital, and housing estates and transports it to a composting facility near one of three transfer stations. The facility, which is operated by a contracted company, has a capacity to treat 1,000 t/d of organic waste, equivalent to a production of 300 t/d of compost (BMA 2006). The facility employs around 100 people. The cost for the municipality is \$15 per tonne of waste, which is about the same as the cost for landfill (BMA 2005). The compost is sold to farmers at a price of approximately \$60 per tonne.

The Bangkok case illustrates that household composting initiatives are difficult to sustain if there is no continuous support. It is also an example of a city that has chosen to outsource its waste treatment to the private sector.

4.3.2. Dhaka

Dhaka, the capital of Bangladesh, has a population of 7 million, and its waste generation is 3,200-4,000 t/d. The city currently collects less than half of this waste and the rest remains on roadsides, in open drains and in low-lying areas thus impacting the environment and endangering public health.

In response to these problems, an NGO called Waste Concern started a community-based composting project in Dhaka in 1995. This activity is based on public-private and community partnerships, where the public sector is providing land for composting facilities, the NGO is providing technical support and implementing the project, private companies are marketing the compost product, and households are participating by paying a monthly fee of \$0.22 for house to house collection. The original composting facility initiated by Waste Concern was serving 1400 households with a capacity of 3 t/d and produced 0.75 t/d of compost. Two currently operated facilities receive 1.75 and 2 t/d of waste respectively from 1800 households in total. The compost is marketed to farmers through cooperation with a fertiliser company and generates revenue of \$37-74 per tonne. In 1998 the national Government recognised the activity of Waste Concern and extended composting practices to other parts of the country with support from the United Nations Development Programme (UNDP). As a result so far, 26 cities and towns are replicating this model. Apart from Bangladesh, the model is being replicated in Viet Nam and Sri Lanka through support from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

The composting activity in Dhaka is unusual as residents are willing to pay a collection fee although the composting activity is fully operated by an NGO, not by the local government. The operation is financially self-sustaining and the only subsidy received is that the Government provides land for the composting facility free of charge. This case shows that source segregation by urban households is possible to achieve and that compost from a mega-city can be of high quality and sold profitably to farmers.

In 2006, a plan for a large scale composting initiative in Dhaka was registered as a CDM project by Waste Concern together with a Dutch partner and in co-operation with the Government. The project marks the first time that a composting project was registered for CDM. The estimated climate benefit of the project is 89,259 tCO₂e/yr (CDM Project Activities Database 2008). From March 2008, this project started its operation of a 10 t/d facility for market waste and by August 2008 this capacity will be

increased to 130 t/d and also include household waste. The planned capacity to be reached by 2009 is 700 t/d.

4.3.3. Nonthaburi

Nonthaburi is a suburb of Bangkok with about 270,000 inhabitants and a population density of 6,900 people per square kilometre. Daily waste generation is about 360 tonnes. The main activity is centralised composting of market waste operated by the municipality.

In 2002, the municipality started to promote household composting using effective micro-organisms. This activity is still going on but there is no information on how many households are currently involved. Since 2005, the municipality has run a composting centre, where approximately 4 t/d of waste from food markets is treated. This centre was built with financial and technical assistance from the European Union (EU). The compost quality is high and it is sold to farmers. The income supports part of the operating cost for the composting centre, but the municipality views composting mainly as a waste treatment method and not as a revenue source. The municipality estimates that it saves about 1.5% of its waste management expenses as a result of the composting centre.

Currently, the municipality focuses on the composting centre rather than on promoting household composting. The case of the Nonthaburi compost centre is an example of how a municipality can start composting by treating waste only from a single accessible source. Market waste is highly suitable for composting since it is relatively free from pollutants and inert materials. Furthermore, unlike household waste, market waste is easy to collect and there is no need to convince households to segregate their waste, making it possible to get started quickly. Hence, market waste composting can be an entry point for a municipality through which they can gain experience and evaluate the technology. However, market waste is only a small portion of the total amount of MSW, so impact on reduced landfill disposal is limited.

4.3.4. Surabaya

Surabaya, the provincial capital of East Java, is the second largest city in Indonesia with a population of around three million. Surabaya has a collective composting system as well as household composting. In total, more than 40 t/d of waste is composted, around 30 tonnes from markets and 10 tonnes from households. Surabaya city has achieved about 10% reduction of waste (from 1,500 t/d in 2005 to 1,300 t/d in 2007) through composting and waste segregation at source. What makes the city unique is its success in implementing widespread household composting.

In 2000, a university-based NGO called Pusdakota was running campaigns trying to increase people's awareness around waste issues. Pusdakota also took the initiative to start some composting projects. At that time the system for collecting and treating MSW in Surabaya was in poor condition and many citizens were concerned about the situation. When the city's only landfill site was closed due to protests from neighbours, the waste management system in one part of the city essentially collapsed and the situation became unbearable during the transition period to a new landfill. In 2004, the Japanese organisation Kitakyushu International Techno-cooperative Association helped improve waste management in Surabaya and provided technical assistance on

composting. The severe waste related problems seem to have motivated people to take action to improve the situation and over the following years small-scale household composting gradually became common. The city government became interested at an early stage and supported the replication of the composting practice in other areas of the city.

Households can use the compost themselves or sell it. However, for most households, it is not the income from the composting that is the primary motivator but rather the hygienic improvement and visible upgrading of the local environment. Composting is supported by many housewives in particular and efforts to spread composting actively target this group. Composting is carried out in special baskets subsidised by the city government and the technique is relatively easy to handle.

In addition to household composting, a collective system has been developed. This receives waste both from markets and households that cannot compost themselves or that prefer door-to-door collection. The compost product is used by the city government for parks and green areas. The city government has replicated this system by setting up 13 composting centres. NGOs and community groups are involved in collecting organic waste from households and bringing it to these centres. In many cases they are also trying to introduce household composting in the areas where they operate.

Pusdakota has sold nearly 20,000 units of household composting baskets in three years and their approach has also been adopted by other cities in Indonesia. The leading actors in this case are NGOs, community groups and the city government, supported technically by foreign expertise and financially by the private sector.

4.3.5. Phitsanulok

Phitsanulok, with a population of around 80,000, is the hub of socio-economic activity in the lower northern part of Thailand. Waste generation is 1.6 kg/capita/day, or 131 t/d. Composting is carried out at both household/community and municipality levels on the initiative of the municipality.

In the late 1990s the mayor of Phitsanulok started a composting programme based on household composting and small-scale collective composting, with financial and technical assistance from Germany. Households could either do the composting themselves or leave their organic waste to compost centres. The initiative was well received by the residents and composting increased gradually. In Thailand, Phitsanulok became known as a success story and visitors from other parts of the country came to learn from its experience. The municipality received funding from the Ministry of Natural Resources and Environment to carry out training sessions for staff from other municipalities.

After a few years, in spite of the initial success and publicity, the composting activity declined. Some new local community leaders were not as enthusiastic about composting as their predecessors. In addition, households were less willing than before to compost or segregate their waste. They claimed that the composting process was slow and that the time spent on composting did not pay off. The younger generation feel that they have little time to spend on composting and it is mostly in households where a senior person takes care of the compost that the activity continues. As a result, currently, only a small amount of waste is composted.

To improve the treatment of the organic waste that was not composted, Phitsanulok received additional financial assistance from Germany to build an MBT facility. Now operating for a few years, it takes care of all the waste that would otherwise have been disposed directly to landfill. The process degrades the organic waste under aerobic conditions to reduce volume, to stabilise the organic material and to reduce methane emissions from the landfill. Since the waste is not properly segregated at source, the residues are contaminated and not suitable for use in food production. Approximately 80 t/d of waste are brought to the treatment facility.

The municipality is currently planning to hire a private company to run its composting centre and to develop it further. Based on earlier experience with household composting, the municipality regards a centralised system as the only feasible solution. The municipality will pay the same amount or less as the current MBT and landfill operations, while the private company will own the compost and sell it for extra profit (Hantrakul 2007).

4.3.6. San Fernando

San Fernando is a regional capital in the Philippines with a population of around 120,000. It represents a well-functioning community-based composting system.

In San Fernando, the barangays (communities) collect segregated waste including organic waste from each household and compost it using a mechanical rotating system and vermicomposting. The municipality purchases the compost at a fixed price, thereby guaranteeing an income for the barangays. For additional income the barangays also sell recyclable wastes to junk dealers and charge collection fees for each household. When residents have to pay, they also demand a good service, so this system puts some pressure on the barangay leaders to provide good quality services. Some barangays have been able to buy their own waste collection trucks with the money earned from waste collection and recycling together with subsidies provided by the municipality. In some cases these barangays have expanded their waste hauling services into other barangays.

Since the barangays reduce the amount of waste and transport the remaining wastes to a landfill by themselves, they save money for the municipality. The money thus saved can be used to subsidise barangays that want to buy collection trucks and to cover the extra costs related with the guaranteed compost price. This model for financing community-driven activities, where the municipality's savings from reduced need for transportation and landfills are shared with those who do the extra work, seems to be successful and possible to replicate.

4.3.7. Analysis and policy recommendations

The cases presented illustrate that there are various types of composting initiatives. The waste sources targeted, the leading actor, the scale and technology used, and the intended use of the end product can differ. It is not possible to say that any specific model is most likely to succeed. The two cases with the largest amounts of waste composted – Bangkok and Surabaya – represent very different approaches. In Surabaya composting was a bottom-up process and engaged a significant number of households, while in Bangkok the activity is driven by the city government and focuses on composting waste from selected sources in a large-scale facility.

In most cities, households are the largest generators of organic waste and cities that want to achieve substantial reductions of landfill disposal need to develop solutions for this waste stream. The cases show that composting of household waste is a challenge but some initiatives have succeeded. Careful sorting at source is crucial for projects that need to create revenues by selling their product to farmers. The knowledge and motivation of the households is therefore a key factor. However, the Phitsanulok case shows that households' motivation needs to be continuously maintained. Good results at the beginning are no guarantee for success in the long run.

The reasons for citizens to participate are not necessarily economic as mentioned in the Surabaya case. While an economic benefit can make the introduction of composting easier, the local environmental improvement can be more important for many households. A cleaner neighbourhood is a tangible benefit which appears after a short time. Ironically, this means that it may be easier to engage households in areas where the waste collection system is in a poor condition, while households that are used to frequent door-to-door collection may be less motivated to participate.

Different actors have different goals and reasons for their interest in composting. In a typical case, households want clean and healthy neighbourhoods, the municipality wants low waste management costs and satisfied citizens, an environmental NGO wants low levels of pollution, entrepreneurs want profits, waste pickers and unemployed want stable jobs, and farmers may want safe and cheap soil improvers. It can be difficult to fully satisfy all these interests, and one model of composting might meet the goals of some actor groups but not of others. When planning composting projects it is important to clarify the expectations of each stakeholder group and evaluate how a proposed model can meet these expectations. Initiatives that can only meet the expectations of some actors, but actually need the cooperation of others in order to be successful, are likely to fail.

Composting requires continuous effort and quick results should not be expected. The successful cases typically started small and expanded over a number of years. Experience shows that good practices do not automatically spread even to a neighbouring community. Leaders with the ability to engage and encourage groups with different interests are needed.

Many different skills are required for success in composting initiatives. In addition to the technical know-how to carry out the composting, skills in marketing to the agricultural sector and in conducting awareness-raising and education campaigns directed at households may be needed. All these skills usually cannot be found in one single organisation, so the establishment of networks and partnerships is very important.

International cooperation played an important role in some of the cases presented. Development aid organisations can provide vital investment capital and technical expertise that may be lacking. By being active in a number of countries, these organisations can accumulate extensive experience from both successful cases and failures. Aid organisations are in a unique position to transfer know-how from one developing country to another. However, municipalities receiving financial support must be careful about how this affects local entrepreneurs and other actors, such as waste pickers, already involved in waste collection and treatment.

Financial assistance from the local government is vital for composting initiatives run by community groups or NGOs. It is difficult to make composting self-financing through the income from compost. Assistance can be of various kinds as shown by the cases presented; (i) direct subsidies to composting equipment as in Surabaya; (ii) subsidies to support the purchase of waste collection vehicles as in San Fernando; or (iii) in the form of land that is provided for free or at low rent as in Dhaka. The guaranteed compost price in San Fernando is another suitable form of support. Since the municipalities save money when less waste needs to be collected and treated, it is reasonable that they share this financial benefit with those groups who make an extra effort to the benefit of the whole city.

5. Conclusions and recommendations

Many cities in Asia are trying to upgrade their waste treatment systems from the currently prevailing open dumps. Although such upgrading of disposal sites can reduce the local environmental impacts, it is likely to also increase methane emissions and thus contribute to climate change. Decision makers responsible for waste management should be aware of this risk of burden shifting from the local to the global level and seriously consider treatment technologies that are less harmful for the climate.

If the treatment methods currently preferred continue to dominate, GHG emissions from waste treatment in developing countries are expected to increase sharply over the next few decades. To curb this trend, policymakers in charge of waste management, at both the national and the local level, need to promote the following:

- (i) Waste reduction;
- (ii) Introduction of biological treatment methods for organic waste, such as composting and anaerobic digestion;
- (iii) Incineration, in cases where biological methods are not feasible, where the waste composition is suitable, and where gas treatment equipment with high environmental standards can be installed;
- (iv) Landfill gas recovery and utilisation, for existing landfills and in cases where other options are unfeasible and where suitable land is available.

The waste sector is currently responsible for a small percentage of national GHG emissions and may not receive much attention in climate protection policies. However, this chapter has shown that improved treatment of organic waste has significant benefits in addition to climate protection, including:

- (i) Reduced need for final disposal and thus:
 - a. Reduced cost for disposal;
 - b. Extended life-time of existing disposal sites; and
 - c. Reduced need for new sites and thus fewer land use conflicts;
- (ii) Reduced leakage to groundwater and surface waters;
- (iii) Nutrient recycling and improved soil properties, if compost is used as fertiliser;
- (iv) Additional income opportunities for households and communities, if the compost can be sold; and
- (v) Possibility of additional revenue generation through CDM.

As illustrated in other chapters of the White Paper, climate policies cannot be developed in isolation from other sustainable development issues; to be effective they need to be integrated. Organic waste treatment in cities is a good example of an issue where an integrated approach can generate co-benefits as outlined above. By introducing alternative treatment methods, the local environment and the living conditions of citizens can be improved at the same time as GHG emissions are being reduced. For this reason, composting and other improved organic waste treatment methods deserve increased attention by national policymakers and support for such methods should be part of the national climate protection strategies of developing Asian countries.

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Endnotes – Chapter 6

¹ The waste expenditure data are based on per capita expenditure for the national capitals multiplied by the urban population of each country (Hoomweg et al. 1999).

| CHAPTER 7 |

GROUNDWATER AND CLIMATE CHANGE: NO LONGER THE HIDDEN RESOURCE



Chapter 7

Groundwater and Climate Change: No Longer the Hidden Resource

1. Introduction

Groundwater is an important resource for livelihoods and food security of billions of people, especially in developing countries of Asia. Although trends on abstraction and use in each country are not available, globally groundwater is estimated to provide approximately 50% of current potable water supplies, 40% of the water demand of self-supplied industry and 20% of water use in irrigation. In Asia and the Pacific, about 32% of the population uses groundwater as a drinking water source (Morris et al. 2003).

Groundwater contributes to economic development in the region by providing water for irrigation in area such as India, Bangladesh, Nepal and the Northern China Plains and for industrial production. The value of groundwater to society should not be judged solely in terms of volumetric extraction, however. Compared to surface water, groundwater use often yields larger economic benefits per unit volume, due to its availability at local level, drought reliability and good quality requiring minimal treatment (UN/WWAP 2003). Groundwater use is likely to continue to expand in developing countries. Pressures on groundwater resources over the next 25 years in Asia will come from demographic increases, agricultural practices and increasing water demand per capita, coupled with increased urban areas, industrial activity and energy demand (Gunatilaka 2005).

Despite the significance of groundwater for sustainable development in Asia, it has not always been properly managed, which often has resulted in depletion and degradation of the resource. Without proactive governance, the detrimental effects of poor management will nullify (or even surpass) the social gains made so far (Mukharji and Shah 2005). In addition to these existing challenges, groundwater management now confronts a brand new challenge: how to adapt to the potentially negative impacts of climate change on groundwater and its use?

Climate change impacts may add to existing pressure on groundwater resources by (i) impeding recharge capacities in some areas; and (ii) being called on to fill eventual gaps in surface water availability due to increased variability of precipitation. Groundwater contamination is also expected in low elevation coastal zones due to sea level rise. In some vulnerable areas, such impacts on groundwater resources may render the only available freshwater reserve unavailable or unsuitable for use in the near future (IPCC 2007).

To maintain the advantages of groundwater as an important resource for sustainable development and also as a reserve freshwater resource for current and future generations, groundwater management should be more strategic and proactive to cope with potential impacts of climate change. However, groundwater has received little attention from climate change impact assessments compared to surface water resources (Kundzewicz et al. 2007) and most countries in Asia have not yet responded to the effects of climate change on their water management plans.

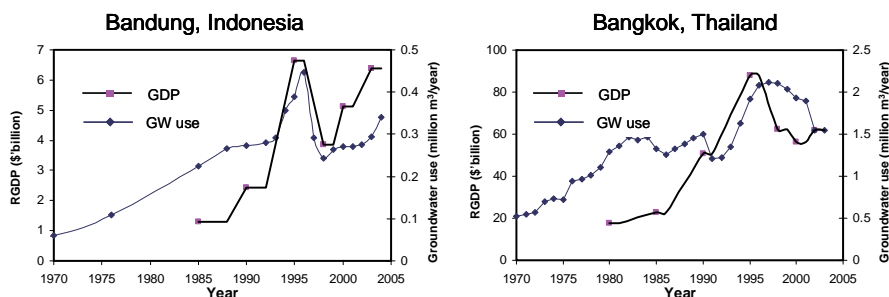
This chapter provides an overview of current groundwater issues and examines the potential and negative effects of climate change on the groundwater resources in Asia. It also explores opportunities for adaptation to the potential impacts of climate change. The risks of climate change impacts are not only a great challenge for water resources management but also for the broader role of water in sustainable development.

2. Groundwater demand and socio-economic development

2.1. Groundwater use

Nearly two billion people in Asia depend on groundwater resources for drinking water. In countries like Bangladesh, China, India, Indonesia, Nepal, the Philippines, Thailand, and Vietnam, more than half of potable water supply is estimated to come from groundwater (UNEP 2002). Some large cities such as Jakarta, Hanoi, and Beijing depend on groundwater as one of the main water sources. Myriad small towns and rural communities also depend on groundwater. For example, 60% of the rural population in Cambodia relies on groundwater (ADB 2007b) and 76% of people who do not have access to piped system depend on tube wells in Bangladesh (ADB 2007c). In urban areas, groundwater tends to be used more for industrial use than human consumption. Industrial use in total groundwater abstraction accounts for 80% in Bandung and 60% in Bangkok. There is a strong correlation between groundwater use and gross domestic product (GDP) in these cities (fig. 7.1).

Figure 7.1. Groundwater abstraction and correlation with city-level GDP

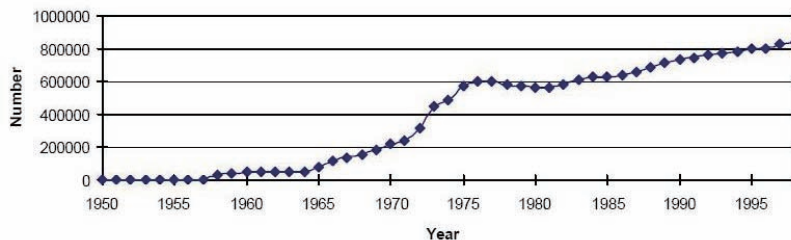


Source: Kataoka et al. 2006

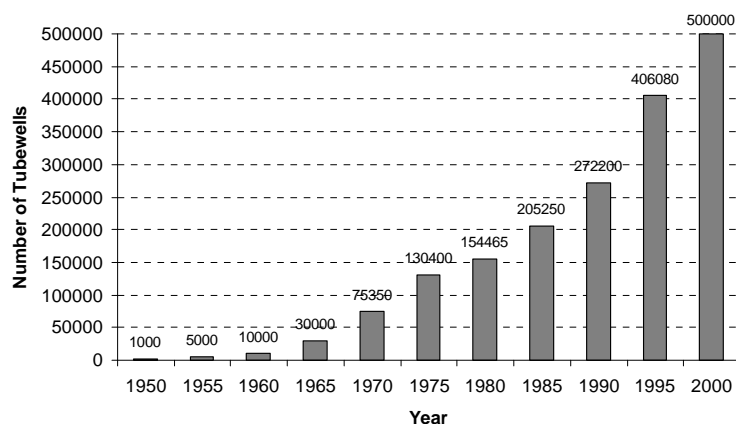
Groundwater supports dynamic agricultural systems in India, Northern Sri Lanka, Pakistan Punjab and the Northern China plains. In India, groundwater provides about 60% of the total agricultural water use accounting more than 50% of the total irrigated area. Similarly, groundwater contributes 50%, 50%, 65% and 70% of total agriculture water supply in Shangdong, Henan, Beijing and Hebei provinces of China respectively (Ministry of Water Resources of China 2000). In Pakistan Punjab, more than 40% of crop water requirement comes from groundwater, producing the majority of food in Pakistan (Qureshi and Barrett-Lennard 1998). The development of tube wells in Hebei Province, China and Punjab, Pakistan (fig. 7.2 and 7.3, respectively) clearly show the increasing dependency of agriculture on groundwater.

Moreover, groundwater irrigation appears to be more productive than surface water irrigation due to more regular and timely availability of water. In India, it is estimated that groundwater irrigated farms produce 1.2 to 3 times higher crop yield than farms irrigated by surface water. In the Pakistan Punjab, investment of about Rs. 25 billion (\$0.4 billion at 2001 prices) in private tube wells generated an annual benefit of about Rs. 150 billion (\$2.3 billion). This investment covered more than 2.5 million farmers who either have their private tube wells or buy water from their neighbours' tube wells (Dhawan 1989).

Figure 7.2. Tube well development in Hebei Province, China



Source: Shah et al. 2001

Figure 7.3. Growth trend of private tube wells in Punjab, Pakistan

Source: Shah et al. 2001

2.2. Problems related to groundwater

As an easily accessible and cheap water resource, groundwater is often abstracted beyond its natural recharging capacity, which results in depletion of the resource and/or degradation of its quality. Major problems identified as a result of over-extraction of groundwater in some areas of Asian cities include:

- Land subsidence
- Depletion in groundwater table
- Groundwater contamination (e.g. from arsenic, fluoride and ammonium)
- Saline water intrusion

In China, groundwater level has declined in 30% of 194 key cities and regions monitored (WEPA 2007). Other Asian cities like Bangkok have experienced excessive drawdown of water tables and suffer from land subsidence due to intensive use of groundwater (fig. 7.4) (IGES 2007). The intensity and the cumulative extent of water level depletion and land subsidence in selected Asian cities in the years 1980, 1990 and 2003 shows that the drop in groundwater levels continues in all cities (table 7.1).

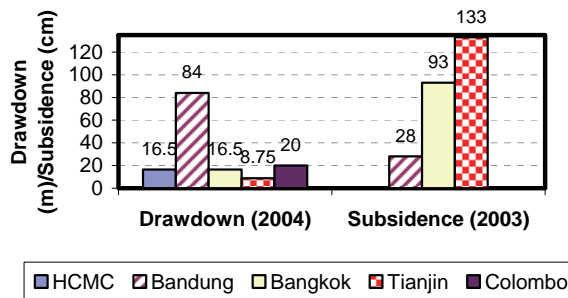
Table 7.1. Effects of groundwater overuse in some Asian cities

Study area	Average drop in water level (m/y)			Average land subsidence (mm/y)		
	1980	1990	2003	1980	1990	2003
Bangkok	1.0	3.0	-1.5	23	25	15
Bandung	1.3	6.5	0.8	-	10	18
Colombo	-	-	1.0	-	-	-
HCMC	0.1	0.95	1.0	-	-	-
Kandy	-	-	2.5	-	-	-
Tianjin	-	-	0.63	119	15	31

Source: IGES 2007

In 2003, the average land subsidence was found to be 15 mm, 18 mm and 31 mm in Bangkok, Bandung, and Tianjin respectively. Land subsidence can affect buildings and structures such as water and sewerage networks and increase groundwater salinity, as observed in Bangkok.

Figure 7.4. Cumulative drop in water level and land subsidence in some Asian cities



Source: IGES 2007

Groundwater quality problems affect the health of millions of people. Arsenic contamination in India, Bangladesh and some other river deltas of Asia has been widely reported but not yet fully controlled. Fluoride contamination constrains provision of safe water access in some parts of India, China and Thailand. A survey in Lamphun Province, Northern Thailand showed that concentration of fluoride in drinking water was up to 15.0 mg/L, while the national drinking water standard for fluoride is 0.7 mg/L. It also revealed that use of fluoride rich water for soaking rice could be a major source of fluoride intake in the surveyed area (Takeda et al. 2007).

In Tianjin, where groundwater also contains a high fluoride concentration, the dental fluorosis rate of local residents was reported to be far higher than national survey results—41% in Tianjin urban area compared to 5.21% national average in city areas (Xu et al. 2008). In addition to naturally occurring contamination, groundwater quality is at a risk from improper sanitation systems, leachate from unmanaged landfill sites, and polluted surface water. Groundwater quality contamination is definitely related to the health of local people, but the state of groundwater quality contamination is not adequately explored due to insufficient monitoring and lack of awareness.

2.3. Current groundwater management practices in Asia

2.3.1. Legislation related to groundwater

Progress in water resource management in Asia is seen in the development and revision of water laws (ADB 2007a). Such basic laws on water resource management often introduce licensing or a permit system for groundwater abstraction which could be a basis of improved groundwater management. Examples include the Water Law of China (2002), Water Resource Law in Lao PDR (1996) and the Water Code of the Philippines (1976). However, implementation is weak because these laws provide only

a framework and no sanctions for poor implementation. In addition, in many countries, groundwater use still lacks any proper legislation.

Where the negative impacts of groundwater overexploitation are evident, generally groundwater use regulations have been developed. Countries such as Japan and Thailand have specific national laws which aim to control groundwater use to mitigate groundwater problems such as land subsidence, but actual control of groundwater use is limited to critical areas under these laws. At the local level, there are more regulations aiming to control abstraction to fit local conditions, with or without national laws on groundwater (table 7.2). Local regulations are generally more useful because they reflect local conditions of groundwater and water use.

Table 7.2. Local regulations related to control of groundwater abstraction/use

Name (Country)	Name of regulations	Background/Purpose
Tianjin (China) ¹⁾	Temporary Measures for Groundwater Management in Tianjin (1987)	To regulate groundwater abstraction to mitigate decline of groundwater level associated with land subsidence
Maharashtra (India) ²⁾	Maharashtra Groundwater Act (1993)	To regulate and control groundwater for conservation of the resource for drinking purposes
Kerala (India) ³⁾	Kerala Groundwater Act (2002)	To provide for the conservation of groundwater and regulation and control of its extraction and use in the State
Bandung (Indonesia) ¹⁾	The West Java Provincial Regulation 16/2001 (2001)	To regulate groundwater to mitigate depletion of the resource
Kumamoto (Japan) ⁴⁾	Groundwater Preservation Ordinance of Kumamoto Prefecture in Japan (1992)	To conserve quality and quantity of groundwater as a common resource of the local people

Sources: ¹⁾ IGES 2007, ²⁾ Phansalkar and Kher 2006, ³⁾ Environmental Law Alliance Worldwide website (<http://www.elaw.org/resources/text.asp?id=2846>), ⁴⁾ Kumamoto Prefecture website (http://www.pref.kumamoto.jp/eco/project/kankyoku/kankyoku11_01.htm).

2.3.2. Organisational arrangements in the public sector

In many cases, two or more agencies or ministries work on groundwater management at national level, and local governments are responsible for implementation. However, coordination between agencies at national level as well as between national and local governments is not always strong enough to implement groundwater control measures. In HCMC, four departments (Natural Resources and Environment, Industry, Agriculture and Rural Development, Transportation and Public Works) have activities related to groundwater management but weak coordination is a barrier to effective implementation and data accumulation (IGES 2007).

In addition, groundwater is often managed separately from surface water. In Indonesia, the Ministry of Public Works is responsible for surface water management and the Ministry of Energy and Mineral Resources for groundwater. Surface water and groundwater are managed by two different departments under the Ministry of Natural Resource and Environment in Thailand. Agricultural ministries also have limited responsibility for agricultural groundwater use in these countries. In China and the

Philippines, a single ministry or a national water policy making body has primary responsibility for both surface water and groundwater management at national level. At the implementation level, however, responsibility tends to be delegated to different sectoral departments, such as irrigation, water supply and industry. Such a sectoral approach without adequate coordination tends to be a barrier to effective use and management of water resources.

2.3.3. Charging system

Groundwater has been exploited free of charge for a long time, but some charges on groundwater abstraction have begun to be introduced in the form of a user charge or tax, in most cases intended as a disincentive to groundwater abstraction. A groundwater charge/tax has been introduced in Bangkok, Bandung, Tianjin, and recently in HCMC. However, effectiveness of these charges on groundwater demand is still limited. For example, in Bandung and Tianjin, groundwater is cheaper than water from the public water supply scheme which is expected to provide an alternative to groundwater. In Tianjin, the agricultural sector, which is the largest user of groundwater, is exempted from the groundwater charge, so charging is not effective in decreasing groundwater demand (IGES 2007).

2.3.4. Alternative water sources

Groundwater pumping cannot be effectively controlled without other water sources to substitute for groundwater demand. In Tianjin, groundwater exploitation in the urban area was reduced by providing alternative water through water transfer from another basin (which may raise additional problems). In the 1960s, Osaka mitigated its groundwater overexploitation problems by development of surface water for industrial use. Groundwater pumping in Bandung could not be reduced despite licensing and pricing measures, partly because there is not enough surface water supply available to meet the demands of the industrial sector, the largest water user in the city. In general, because of limited water availability, groundwater management should address demand rather than developing other sources of water to substitute for groundwater.

3. Potential impacts of climate change on groundwater resources

The potential impacts of climate change on water resources in general have been recognised for some time, although there has been comparatively little research relating to groundwater (IPCC 2001). The principal focus of climate change research with regard to groundwater has been on quantifying the likely direct impacts of changing precipitation and temperature patterns (Yusoff et al. 2002; Loaiciga et al. 2000; Arnell 1998). Such studies have used a range of modelling techniques such as soil water balance models (Kruger et al. 2001; Arnell 1998), empirical models (Chen et al. 2002), conceptual models (Cooper et al. 1995) and more complex distributed models (Croley and Luukkonen 2003; Kirshen 2002; Yusoff et al. 2002), but all have derived changes in groundwater recharge by assuming that parameters other than precipitation and temperature remain constant.

Box 7.1. Examples of potential impacts of climate change on groundwater resources

<p>Direct impacts</p> <ul style="list-style-type: none"> • Variation in duration, amount and intensity of precipitation and evapotranspiration will increase or decrease recharge rates. • Rising sea levels will allow saltwater to penetrate farther inland and upstream in low lying river deltas. • Variation in CO₂ concentrations may affect carbonate dissolution and the formation of karst.
<p>Indirect impacts</p> <ul style="list-style-type: none"> • Land cover changes (viz. natural vegetation and crops) may increase or decrease recharge. • Increase in groundwater extraction due to decrease in reliability of surface water as a result of increased floods and droughts. • Increase in flood frequencies may affect groundwater quality of alluvial aquifers. • Variation in soil organic carbon content may affect the infiltration properties above aquifers.

3.1. Potential impacts due to change of temperature and precipitation

Spatial and temporal changes in temperature and precipitation may modify the surface hydraulic boundary conditions of, and ultimately cause a shift in the water balance of an aquifer. For example, variations in the amount of precipitation, the timing of precipitation events, and the form of precipitation are all key factors in determining the amount and timing of recharge to aquifers. In Central Asia, output from the MRI-CGCM2.3.2 coupled atmosphere-sea surface global circulation model for the period 2080-2100 shows a rise in temperature of 3.5–4.5°C and a decrease in precipitation. For South Asia, 2.5–3.5°C increase of temperature and an increase in precipitation are projected. Changes in the amount of precipitation are expected to decrease mean runoff by 1 mm/day in Central Asia and to increase mean runoff by a similar amount in South Asia. Due to the change in the variability of precipitation, surface water resources are likely to become more unreliable, thus precipitating a shift to development of more “reliable” groundwater resources, as has been observed in Taiwan (Hiscock and Tanaka 2006).

The changing frequency of droughts or heavy precipitation can also be expected to impact on water levels in aquifers. Droughts result in declining water levels not only because of reduction in rainfall, but also due to increased evaporation and a reduction in infiltration that may accompany the development of dry topsoils. Paradoxically, extreme precipitation events may lead to less recharge to groundwater in upland areas because more of the precipitation is lost as runoff. Similarly, flood magnitude and frequency could increase as a consequence of increased frequency of heavy precipitation events, which could increase groundwater recharge in some floodplains.

3.2. Degradation of groundwater quality by sea level rise

As global temperatures rise, sea level rise is also expected due to the melting of ice sheets and glaciers. Rising sea levels would allow saltwater to penetrate farther inland

and upstream in low lying river deltas (IPCC 1998). Higher salinity impairs surface and groundwater supplies, damaging urban water supplies, ecosystems, and coastal farmland (IPCC 1998). Furthermore, a reduced groundwater head caused by lower rainfall will aggravate the impacts of sea level rise. Saline intrusion into alluvial aquifers may be moderate, but higher in limestone aquifers. Reduced rates of groundwater recharge, flow and discharge and higher aquifer temperatures may increase the levels of bacterial, pesticide, nutrient and metal contamination. Similarly, increased flooding could increase the flushing of urban and agricultural waste into groundwater systems, especially into unconfined aquifers, and further deteriorate groundwater quality.

About 45% of population in the world lives in the low elevation coastal zone and about two thirds of the population residing in this zone are in Asia (IHDP 2007). Sea level rise has already affected a large population, resulting in a huge loss of capital value, land, and precious wetlands, and incurring a high adaptation/protection cost (table 7.2). In Asia alone, projected sea level rise could flood the residences of millions of people living in the coastal zones of South, Southeast and East Asia such as Vietnam, Bangladesh, India and China (Wassmann et al. 2004; Stern 2006; Cruz et al. 2007).

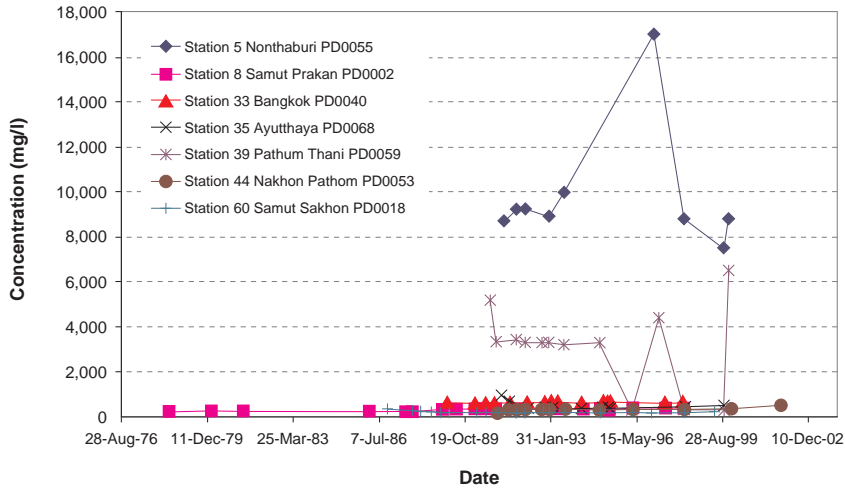
Table 7.3. Impacts of sea level rise in the Asia-Pacific region

Country	People Affected		Capital Value at Loss		Land at Loss		Wetland at Loss	Adaptation/Protection Costs	
	Number of People ('000)	% total	\$ 'million	% GNP	km ²	% total	km ²	\$ 'million	% GNP
Bangladesh	71,000	60	-	-	25,000	17.5	5,800	>1,000	>0.06
China	72,000	7	-	-	35,000	-	-	-	-
Japan	15,400	15	849,000	72	2,300	2.4	-	>156,000	>0.12
Kiribati	9	100	2	8	4	12.5	-	3	0.10
Marshall Is.	20	100	160	324	9	80	-	>360	>7.04

Note: Assuming existing development and a 1m rise in sea level. All impacts assumed no adaptation while adaptation assumes protection, except in areas of low population density. Costs are 1990 US dollars. Source: OECD 2003

The salinization of aquifers has been detected in many areas of Asian cities located in coastal areas. The chloride concentration exceeds the allowable limit of 250 mg/L in some monitoring locations of Bangkok (IGES 2007). As an example, a seasonal concentration of chloride concentration in Phra Pradaeng aquifer of Bangkok is shown in figure 7.5. In monitoring stations 8 (Samut Prakan PD0002) and 60 (Samut Sakhon NL 0032) that are located adjacent to the coast, salinity levels are likely to be increased as a result of sea level rise.

Figure 7.5. Chloride concentration in Phra Pradaeng aquifer, Bangkok



Source: Babel et al. 2006

In HCMC, saltwater intrusion has been observed in some districts and this phenomenon seems to have been escalating, with continuing drawdown of the water table due to excessive groundwater abstraction to meet the growing water demands in the city (IGES 2007). In Manila, tidal inflow of seawater during high tide into the Pasig River contributes to the high salinity of groundwater in Pasig City and vicinity (Philippines National Water Resource Board 2004). Sea level rise due to climate change may increase seawater inflow into freshwater aquifers in parts of these coastal cities where hydraulic connections to aquifer beds are exposed at the sea floor.

3.3. Potential impacts of land use change caused by climate change

Climate change studies suggest that some Asia-Pacific forests and vegetation may experience some initially beneficial effects from climate change and enhanced atmospheric CO₂ concentrations. Any vegetation change scenarios will have direct and indirect impacts on groundwater recharge. For example, the projected decline of steppe and desert biomes on the Tibetan Plateau may be accompanied by an expansion of conifer, broad-leaved, and evergreen forests and shrubland. Expanded forest cover may increase groundwater recharge in the Tibetan Plateau, with consequent changes in downstream river flows. In addition, studies suggest significant shifts in the distribution of tree species in China in response to warming of 2–4°C, including the migration of forest communities into non-forested areas of East China (CSIRO 2006). The increase in forest area may increase the groundwater recharge in East China.

Changes in precipitation and temperature caused by the elevated level of CO₂ in the atmosphere can increase the infiltration rate of water through the vadose zone. A model that simulates the effect of increased CO₂ level on plants, groundwater and the vadose zone was applied in subtropical and Mediterranean regions of Australia. The subtropical regions responded more to the frequency and volume of precipitation

whereas the Mediterranean region was influenced more by changes in temperature. In both locations, groundwater recharge rate varied significantly i.e., 75-500% faster in Mediterranean region and from 34% slower to 119% faster in subtropical regions (Green et al. 2007).

Urban built-up areas have expanded rapidly, replacing either forest or agricultural land (i.e., replacing vegetation with concrete and bitumen). In cases such as Bandung, Bangkok, Shanghai, Colombo and Kandy, the change in agricultural land is mainly from rice paddies. Further, in Colombo and Kandy peri-urban areas, the cropping efficiency in the late 1970s was nearly 200% with two cultivation seasons, while in the last decade, this dropped to an average of 140%. This has reduced waterlogging of the paddy fields and thus reduced the consequent subsurface flow and groundwater recharge, influencing water resources in the surrounding urban region (IGES 2007). Reduced waterlogging of other peri-urban areas can be expected to reduce groundwater recharge to aquifers used by urban industry and populations.

3.4. Potential degradation of groundwater by afforestation and carbon sequestration

Forests play an important role in mitigating climate change. The IPCC recognises that sustainable forestry offers reduction in emissions from deforestation and forest degradation (REDD), afforestation, increasing sequestration in existing forests, supplying biomass for bio-energy and providing wood as a substitute for more energy intensive products such as concrete, aluminium, steel and plastics, as potential carbon mitigation options. The heightened global interest in providing incentives for forest conservation by valuing standing forests as carbon sinks and reservoirs is encouraging (see Chapter 4, this volume). However, increased forest cover will have impacts on groundwater recharge, through increased evapotranspiration, that may require on-site research before proceeding with specific projects. Some research has revealed that groundwater recharge is generally lower in forested areas than non-forested areas (Scanlon et al. 2006).

Carbon sequestration in aquifers may have unforeseen impacts on human health due to groundwater contamination (Jackson et al. 2005). When carbon dioxide enters the groundwater it can increase its acidity, potentially leaching toxic chemicals, such as lead, from rocks into the water, making groundwater unsuitable for use. To address and manage this risk, further study is needed on soil, geology, and optimum amounts of sequestration that will not cause increased acidity in groundwater.

3.5. Increase of groundwater dependency due to changes in water use

In the future, dependence on groundwater may increase due to the increasing unreliability of using surface water. It is projected that in many areas the quantity of surface water will vary and its quality will be degraded because of increased drought and flood events as a result of climate change (Kundzewicz et al. 2007). IPCC summary reports indicate that there is a very high likelihood that current water management practices will be inadequate to reduce the negative impacts of climate change on water supply reliability.

4. Adaptation measures and strategies

To minimise risk to stable water supplies, water managers design their water supply plans in accordance with climate variability based on historic climate data. However, such data may be less useful for future water management because of increased variability caused by climate change. Water resource managers will need to build new models of climate variability and greater allowance for risk into future water supply plans, in which groundwater management should be well integrated.

There is no panacea to minimise the risk of climate change to groundwater. The first step is to mainstream adaptation into water management plans, strengthening the existing management systems and measures to cope with both current and potential impacts. Groundwater volumes in aquifers need to be increased in order to conserve groundwater, maintaining groundwater ecosystems and storing reserve water supplies underground. Second, water sources should be diversified and water conservation should be promoted to minimise the risk of water shortages especially in droughts. Third, institutional arrangements to promote adaptation options are needed, which may require a paradigm shift in groundwater management. Some of the structural and institutional options available are discussed in this section.

4.1. Structural adaptation

Structural adaptation consists of building physical infrastructure or techniques that can increase storage capacity of aquifers or abstraction from watercourses or that minimise the deterioration of water quality. Some structural adaptation measures are:

- rainwater harvesting,
- artificial recharge of aquifers,
- desalination plants,
- underground dams,
- reservoirs and check dams.

In this chapter rainwater harvesting, artificial recharge of aquifers and construction of ponds are discussed, as they are simple, low cost and feasible in developing countries.

4.1.1. Promoting water harvesting and conservation technologies

Rainwater harvesting is a simple and low cost technique that involves the capture and storage of rainwater from roofs and ground catchments for domestic, agricultural, industrial and environmental purposes. Water harvesting has many advantages in rapidly growing cities and under future climate change scenarios. In many Asian cities, river water is already unsuitable for domestic and other purposes, and needs a huge financial investment and major institutional reform to restore the polluted and degraded river to its original condition. Rainwater harvesting can enhance the water availability at any specified location and time, increase groundwater levels and improve groundwater ecosystems. Elevated rainwater tanks save energy as groundwater has to be pumped from underground. In addition, rainwater harvesting reduces floods and soil erosion. Therefore, rainwater harvesting yields numerous social and economic benefits, and contributes to poverty alleviation and sustainable development.

Some traditional and innovative techniques are available to collect rainfall and runoff that can serve as alternative water sources in drought prone areas to minimise the stress on groundwater and in low elevation coastal zones where contaminated aquifers are a problem. Allocating 1-5% of catchment areas to water harvesting can meet the needs of water deficit communities (Sharma and Smakhtin 2006). However, a policy framework and institutional mechanism is needed to promote water harvesting at different administrative levels and jurisdictions.

Rainwater harvesting for domestic use – In Asia, rainwater harvesting for domestic use is common. Rainwater harvesting from roof top areas is also beneficial in low elevation coastal zones where groundwater recharge is not useful due to saline contamination of aquifers. In addition to domestic use, rainwater harvesting can also be used for groundwater recharge with some recharge technologies. Recharging aquifers by rainwater in coastal areas can dilute to some extent the elevated salinity concentration, making marginal supplies usable.

Box 7.2. Potential of roof top rainwater harvesting

The potential of roof top rainwater harvesting for a plot size 250 m² for an average annual rainfall of 1,000 mm, assuming 50% of plot area as roof area would be (0.5x250x1x1000) 125,000 litres. Assuming that only 60% of this potential could be stored, the quantity of water available would be (0.6x125, 000) 75,000 litres/year. The quantity of water available each day would be (75,000/365) 250 litres per plot. With a family of 5, the availability of water would be (250/5) 50 litres per person per day. As the average daily water requirement is approximately 100 litres per day, rainwater harvested from the roof could satisfy half of the daily water requirement.

Source: WAC, UNHABITAT and DUADGMP 2007

In some states and cities of India, rainwater harvesting is mandatory for new buildings and is imposed based on size of footprint area, plot area, number of storeys, and private, government, commercial or residential use. Some states such as Indore provide incentives such as a reduction in property tax while others like Tamil Nadu have strict enforcement by mandatory installation and cost recovery from owners.

Table 7.4. Legislation on rainwater harvesting in some Indian states/cities

State/City	Responsible agency	Mandatory	Conditions
New Delhi	Ministry of Urban Affairs and Poverty Alleviation	Yes	All new buildings with a roof area >100m ² , New buildings to be developed with an area >1000m ²
Indore	-	Yes	All new buildings with an area of >250 m ² . A 6% reduction in property tax has been offered
Hyderabad	-	Yes	All new buildings with an area of equal to or more than 300 m ²
Chennai	-	Yes	All new three-storied buildings (irrespective of the size of the rooftop area)
Rajasthan	-	Yes	All public infrastructures on plots covering more than 500 m ² in urban areas
Mumbai	-	Yes	All buildings constructed on plots size of > 1,000 m ²
Gujarat	State Roads and Buildings	Yes	All government buildings

Source: WAC, UNHABITAT and DUADGMP 2007

Water policies and regulations affect the popularity of rainwater harvesting projects. Policies can be improved by addressing the concerns of key stakeholders, providing rainwater harvesting education and diffusion techniques, determining the optimal role of rainwater harvesting beside the supply from other water sources in different regions of the country, and providing an optimum mix of incentives and regulations to maximise uptake of rainwater harvesting (Sundaravadivel et al. 2006).

Box 7.3. Sustainable rainwater harvesting project in the Philippines

The rainwater harvesting project in Capiz province of the Philippines was an innovative and sustainable project, supported by IDRC, Canada in 1989. The project consisted of two components (i) construction of 500 rainwater harvesting tanks ranging from 2-10 m³ in size; and (ii) provision of loans for income generating activities such as livestock rearing.

The villagers were provided a loan of \$200 which could be paid back over 3 years. The villagers bought pigs for about \$25 each and after some time they sold them at a very good price, about \$90 each. The profit from selling the pigs was used to pay back the cost of rainwater harvesting tanks and the loan itself. Therefore, the project provided multiple benefits viz. access to water, earnings for livelihood and also manure for agricultural production.

Source :UNEP-IETC 2002

Whether rainwater harvesting can be adopted in a particular location depends on the amount and intensity of rainfall. In Asia, the rainfall is not uniform throughout the year, so rainwater harvesting serves as only a supplementary source for domestic use. The success of rainwater harvesting systems depends on (i) the quantity and quality of other water sources available; (ii) the size of household and per capita water demand;

and (iii) financial conditions. Rainwater harvesting systems are more cost effective than tube wells, especially if installed in existing buildings with suitable roofing material. In Northeast Thailand, the cost of a rainwater storage tank (jar) is about \$1/L, with negligible operation and maintenance costs (UNEP-IETC 2002). Care must be taken, however, to check water quality parameters if the water is to be used for drinking purposes, as lead and zinc contamination from corrugated iron roofs can be higher than allowed by drinking water standards.

Rainwater and run-off water harvesting for agriculture - As agriculture is the largest user of groundwater in Asia, the anticipated stress on groundwater due to climate change can be minimised by promoting farming based on rainwater and runoff harvesting. Micro-catchment based cropping with field bunding, contour bunding, ridging, conservation furrows, key line and contour cultivation can concentrate rainwater in a small portion of the cultivated area to be used for irrigating crops. Arid horticulture crops such as pomegranate, dates and other crops can be successfully grown in water scarce regions (Sharma and Smakhtin 2006).

Khadin is a system of water harvesting and moisture conservation that is very popular in India. *Khadin* is best in deep soil plots surrounded by a natural catchment, but can be used where rainfall is as low as 150-350 mm/year. The runoff from upland areas is collected in the adjoining valley by constructing an earthen bund. The average productivity of chickpeas cultivated in this system ranges from 2.5 to 3.0 tonnes per hectare (t/ha), even without using commercial fertilisers (Sharma and Smakhtin 2006).

Similarly, small and medium sized water harvesting ponds can harvest precipitation and runoff to mitigate water scarcity. One successful example of a conservation pond in Dhading watershed in Nepal provides a reliable source of water for irrigation and livestock. The immediate area has 25 families cultivating crops and raising 226 head of livestock. The 105 m³ water supply from the \$2,000 pond provides irrigation and livestock needs, even during the dry season. Management of the pond by the local community is working well (Clemente et al. 2003).

On-farm reservoirs (OFR) can be used to store enough water for irrigation and fish culture in the eastern part of India (Pandey et al. 2005). One study on the viability of a rice-fish-mustard integrated farming system, showed that an OFR with a side slope of 1:1 and depth of 2.4 m occupying 17.5% of the field area (field size was only 800 m²) can meet the demand for supplemental irrigation for rice, pre-sowing irrigation for mustard and water for fish culture. Economic analysis revealed a benefit/cost ratio of 1.87. In the Soan River catchment in the northwest Himalayas, benefit/cost ratios from 0.41 to 1.33 were found for water harvesting structures of different sizes for maize and wheat production (Goel and Kumar 2005).

Despite the potential of rainwater and runoff harvesting for domestic and agricultural use in Asia, few governments have made rainwater harvesting structures mandatory. Government policies on water resources and development should consider the need to encourage community participation while planning and executing any water resources development and management projects. Existing traditional methods on water harvesting and conservation can be improved by modern technologies. Participatory water harvesting systems for domestic and agricultural use can be integrated into water resources development and management plans at local, regional and national levels (Sharma and Smakhtin 2006).

Managed aquifer recharging – There are more than 800,000 dams constructed around the world, but these store only 20% of surface runoff. In India, which has built the majority of the dams in the world, about 1,150 km³ per year of rainwater still runs into the sea in the form of “rejected recharge” (INCID 1999). Groundwater supplies could be increased significantly if only a small portion of this rejected recharge was stored underground. But this requires sound aquifer management with planned decline of the water table in the pre-monsoon dry months. Partially empty aquifers enhance recharge from both monsoon rains and return flows from irrigation water. Many developed nations have already practiced this kind of aquifer management. For example, artificial groundwater recharge contributes to total groundwater use at the rate of 30% in Western Germany, 25% in Switzerland, 22% in the USA, 22% in Holland, 15% in Sweden and 12% in England (Li 2001).

In Asia, few studies have been conducted on artificial recharge of aquifers. In India, the Central Ground Water Board (CGWB) conducted a feasibility study on artificial recharge in drought prone areas of Gujarat, Maharashtra, Tamil Nadu and Kerala. It found that the cost for construction and operation of artificial recharge structures was reasonable, but the cost for artificial recharge of wells in alluvial aquifers and tidal areas was very expensive. Moreover, the cost of artificially recharged water used for irrigation was comparatively higher than other sources. The cost of recharged water was about \$15-50/ha/crop. The cost of artificially recharged water for domestic use (about \$0.05-\$0.15/person/year) was considered reasonable, especially in water scarce areas. The initial investment and operation cost of artificial recharge was much less than potable water supplied by tankers. Furthermore, if governments implement aquifer recharge programmes as relief work (which generally excludes labour costs), the cost could be further reduced.

The combination of several technologies can also reduce the costs. For example, in Maharashtra, the cost of a hybrid, connector well tank system was only \$900 as compared to a percolation tank system (approximately \$120,000), although both systems have a similar degree of recharge (CGWB-UNESCO 2000) (tables 7.5 and 7.6 show the costs of some artificial recharge methods and systems).

Table 7.5. Economics of artificial recharge methods in India

Type of Artificial Recharge Structure	Capital Cost per 1,000 m ³ of Recharge Structure	Operations Cost per 1000 m ³ /year
Injection well (alluvial area)	\$551	\$21
Injection well (hard rock)	\$2	\$5
Spreading channel (alluvial area)	\$8	\$20
Recharge pit (alluvial area)	\$515	\$2
Recharge pond or percolation pond (alluvial area)	\$1	\$1
Percolation tank (hard rock area)	\$5	\$1
Vasant Bandhava or check dam	\$1	\$1
Tidal regulator	\$56	\$15

Source: <http://www.unep.or.jp/etc/Publications/TechPublications/TechPub-8e/recharge.asp>

Table 7.6. Cost of artificial recharge system

System	Volume (m ³)	Cost (\$)
Cement jar	1	20
Fibro-cement tank	70-80	756-1,513
Masonry underground tanks	21	202
	200	1,412
	300	4,538
Recharge trench	-	50-252
Recharge through hand pump	-	13-63
Recharge through dug well	-	126-252

Source: CGWB-UNESCO 2000

In addition to the harvested rainwater and runoff water, reclaimed wastewater can also be used for groundwater recharge. Groundwater recharge by treated wastewater has already been practiced in some countries. This practice has some advantages such as additional natural treatment or storage to buffer seasonal variations of water availability. However it should always be evaluated carefully before being adopted in developing countries. The major concerns of groundwater recharge by reclaimed wastewater are risks of microbiological and chemical contamination present in the reclaimed wastewater.

4.2. Institutional adaptations and considerations

4.2.1. From groundwater management to groundwater governance

It is essential to shift from management mode to governance mode to successfully address and solve the key issues and problems related to groundwater. Global Water Partnership (2000) defines water governance as a range of political, social, economic and institutional systems that are in place to develop and manage water resources and the delivery of water services at different levels of society. The different roles and responsibilities of agencies working in the water sector need to be clearly defined with one agency mandated to develop, implement and enforce a groundwater protection plan. This agency should not have any conflicts of interest that will compromise its ability to work independently. An agency involved in approval of water source development and control of the quality of the resource but not directly involved in water source development is usually preferred.

Groundwater management involves hydrologists and water managers, but groundwater governance also takes into account the concerns of multiple stakeholders including hydrologists (and other scientists), policymakers, and most importantly, users. Groundwater governance includes participation by the state, markets and even individuals depending on the nature of the groundwater challenge. Attention has to shift from government policy to governance which is multi-level, multi-actor, multi-faceted, multi-instrumental, and multi-resource based (Mukharji and Shah 2006).

Promoting local management in groundwater - Unlike surface water, groundwater development is often carried out on an individual or small group basis and does not demand a larger institutional framework for water provision (Bhandari and Shivakoti 2005). Therefore, local groundwater management can be an effective way of managing

groundwater resources. Decentralised collective management is often mentioned as an alternative or supplementary option (Chebaane et al. 2004). However, promoting local groundwater management needs guidance and support from central governments.

Groundwater users often employ self-regulation to control and manage groundwater resources locally (table 7.7). Some of the lessons that can be drawn from local groundwater management are (i) potential users should be included in making the regulations; (ii) local groundwater management is possible even without a formal local organisation; (iii) simple rules also work; (iv) support from local government can help to widen the scope of groundwater management with other disciplines; and (v) promoting local groundwater regulation is not difficult, costly or sensitive. Therefore, promoting and supporting local groundwater management can reduce the burden on central governments and ensure the sustainability of groundwater resources management.

Table 7.7. Summary of local groundwater management cases

Case	Country	Size (ha)	Type of management	Measures
Panjgur	Pakistan	2,000-3,000	Informal norms	Ban on dug wells
Mastung	Pakistan	2,000-3,000	Informal norms, committee	Spacing rules, zoning
Nellore	India	1,500	Informal norms, local government	Water saving, recharge, ban on boreholes
Saurashtra	India	Scattered	Informal norms, religious leaders	Recharge, regulation of wells

Source: Steenbergen 2006

Assigning groundwater use rights

Well defined groundwater use rights entitle individual users or user groups to an abstraction allocation at a certain point in time or during a specified time period in certain aquifer conditions. Groundwater use rights needs to be carefully designed, changed and adapted to different conditions. For groundwater use rights to function as a management instrument, the following aspects need to be in place (i) initial allocation; (ii) a registration mechanism and maintained registry system; (iii) a functioning monitoring system; (iv) enforcement of limits set by individual or communal use rights; and (v) a credible sanctioning system (Kemper 2007). To establish groundwater use rights, groundwater should be regarded first as a public good among groundwater users.

Table 7.8. Definition of ownership of groundwater in selected Asian countries

	Definition	Country
Group 1	Groundwater is defined as a common property by statute. The Government is delegated responsibility to manage and allocate water resources.	Bangladesh, China, Laos, Indonesia, the Philippines, Vietnam
Group 2	There is no definition of groundwater ownership in statutory form, but it is generally recognised that groundwater is a common property and the national government has a responsibility to manage and allocate the resource.	Thailand
Group 3	Groundwater is regarded as private property of landowners in common practice or in common law.	Japan, India, Sri Lanka

Introducing a pricing scheme

While some countries in Asia have already introduced groundwater tariffs or fees, in most cases they are not successful, as discussed in section 2.3.3. Since abstraction of groundwater usually takes place on private land and with private equipment, a unique pricing mechanism is needed. In addition to a price of the groundwater resource itself, pricing the other inputs needed in order to pump groundwater such as the pump, borehole, or energy can also be included in a pricing scheme (Kemper 2007).

Pricing the groundwater resource - If users pay for abstraction of groundwater resources based on volumetric metering, there must be effective tools to monitor groundwater use and levels. One tool is remote sensing, which can help calculate groundwater use based on the crop cover (Kemper 2007).

The groundwater pricing mechanism in Bangkok can be taken as a successful example. A groundwater charge was introduced in 1985 in the Bangkok metropolitan region, except for Nakhon Pathom and a part of Samut Sakhon. However it had a little effect on the reduction of groundwater abstraction partly because the rate was cheaper than the piped water supply. To reduce groundwater extraction, the groundwater charge increased gradually until 2003, and an additional charge entitled “groundwater preservation charge” was introduced in 2004. As a result, groundwater users now pay more for groundwater than water from the piped public water supply scheme. By combining a strict pricing system with expansion of public water supply, abstraction of groundwater has decreased and land subsidence has been partly mitigated. The groundwater preservation charge is innovative because it is earmarked for research and groundwater conservation activities by the Groundwater Act.

Energy pricing - Energy pricing is seen as a political agenda in many developing countries and some countries even apply zero tariffs (e.g. the states of Tamil Nadu and Andhra Pradesh in India (Bhatia 2005)). This kind of pricing mechanism will have detrimental effects on groundwater and a true price of groundwater cannot be maintained. One option could be lump sum payments to small farmers that would permit them either to pay the full electricity bill or, if they reduce their pumping, pay a lower bill and use the “gain” for something else. This mechanism, to some extent, would not distort the true price of groundwater (World Bank 2006).

Defining groundwater protection zones

Each aquifer has its own recharge rate and can sustain a certain amount of groundwater withdrawal. If groundwater extraction volumes exceed the recharge rate several negative consequences will occur such as water level decline, land subsidence, and increased salinity. Therefore, defining groundwater protection zones according to the safe yield of the aquifer will help to implement policy instruments such as a ban on boreholes and dug wells, defining the limits of withdrawal, imposing groundwater extraction fees, and other incentives. Groundwater protection zones can be classified according to the level of vulnerability to groundwater extraction and these should be protected from some potentially polluting activities, viz. urbanization, solid waste dumping, and chemical disposal, mining and quarrying. To prevent diffuse pollution from agricultural land use, groundwater protection options include bans or import controls on pesticides and the adoption of good agricultural practice codes. Once

groundwater protection zones are defined, more complementary approaches can be initiated such as public information campaigns and groundwater user groups.

4.3. Integrating adaptation strategies into national policy and planning

Adaptation measures need to be addressed in the context of development policies on poverty reduction, agricultural development, water resources development and disaster prevention. Integrating adaptation concerns into sustainable development planning processes is a necessary strategy for long term groundwater protection. In many developing countries it is difficult to integrate adaptation concerns into national policy due to (i) low staff capacity for planning, monitoring and evaluation; (ii) poor data on adaptation options and weak information sharing across sectors; and (iii) limited awareness of adaptation among stakeholders (UNFCC 2007).

Since groundwater plays a vital role in economic development of developing countries, prohibiting or limiting access to groundwater is tantamount to stopping development. Agriculture and industry depend heavily on groundwater, so policies dealing with agriculture and industrial development must try to incorporate the impacts of climate change on groundwater resources.

As discussed in section 4.1.1 structural adaptation measures such as rainwater harvesting techniques for domestic use and for groundwater recharge is considered as a low cost and highly decentralised technique. Therefore, these adaptation options with the provision of suitable incentives should be taken as a part of integrated water resources management (IWRM) principles and incorporated into national water management plans.

4.4. Capacity building, education, training and public awareness

Stakeholders' inclusion, empowerment and capacity building at all levels, especially in universities and centres of excellence, are vital to enable developing countries to adapt to climate change. Providing education and training to local communities about rainwater and runoff water harvesting for domestic use, agriculture use and for groundwater recharge will enhance the structural adaptation options to cope with current and anticipated future problems. External support is needed for institutional capacity building, including establishing and strengthening centres of excellence and building up hydro-meteorological networks. Training for stakeholders in all sectors would help to develop specialised tools for planning and implementing adaptation activities and thus promote action by local and national governments (UNFCC 2007).

In general, many government agencies of developing countries fail to explain the importance of groundwater resources and the potential impacts of climate change on groundwater. Accordingly professional groups and the public lack interest in working on groundwater resources management issues. Therefore, all water users and stakeholders, including government staff, need to be educated about the importance of groundwater to ensure sustainable management of groundwater resources.

4.5. Opportunities for adaptation funds

Funding is needed for successful implementation of adaptation plans and projects, especially in developing countries. With guidance from the UNFCCC, the Global Environment Facility (GEF) is operating the GEF Trust Fund, Special Climate Change Fund (SCCF) and Least Developed Country Fund (LDCF). Other funding opportunities for adaptation projects include (i) Adaptation Fund under the Kyoto Protocol; (ii) funds from other multilateral environmental agreements (MEA); and (iii) bilateral and multilateral development funds.

The financial resources available for adaptation in the funds currently operated by GEF only amounted to \$275 million in August 2007. The Adaptation Fund could receive \$80-300 million per year for the period 2008–2012 (UNFCCC 2008) from a 2% levy on clean development mechanism projects. Funds should be mainstreamed into structural and institutional adaptation countermeasures such as rainwater harvesting in coastal areas and urban centres. Some funds are needed for capacity building to identify investment needs and to assess the vulnerability of groundwater resources to climate change. Additional funding is needed to strengthen institutions responsible for climate change and groundwater resources management.

5. Knowledge gaps and future research needs

Very few studies have been conducted on the potential direct and indirect impacts of climate change on groundwater resources and consequently its impacts on socio-economic condition in local, regional and national level of developing countries. Therefore research should start from very basic steps such as data collection (where basic data does not exist) to adaptation options which are necessary to fill in the knowledge gaps on the potential negative impacts of climate on groundwater resources and reducing the associated risks. The immediate research questions include:

- (i) What are the social and economic impacts of climate change on groundwater resources?
- (ii) What are the potential impacts of climate changes on groundwater resources at local scales? What downscaling studies of global climate change models are needed to predict the impact of climate change on a local scale and on groundwater resources?
- (iii) What are the critical thresholds of groundwater extraction amount under climate change scenarios?
- (iv) How can groundwater monitoring under the climate change scenarios be improved?
- (v) Are current groundwater water management structures and institutional capacity able to deal with projected climate change impacts?
- (vi) What are the adaptation options available to cope with climate change impacts on groundwater resources and have their economic viability, social acceptance and environmental impacts been adequately evaluated?
- (vii) How can an appropriate network and platform be created to investigate groundwater impacts and share up-to-date data/information necessary for formulating structural and institutional measures to adapt to the climate change impacts on groundwater?

6. Conclusions and recommendations

In many regions and for billions of people in Asia, groundwater is an irreplaceable resource for livelihoods and agriculture. Adverse impacts of climate change on groundwater resources are expected, including changes in recharge rates, saline intrusion in coastal aquifers, and decreased long term groundwater storage. Overall, however, groundwater is expected to be relatively unaffected by the climate change due to its buffering capacity. Groundwater, therefore, may increase in importance and help to ameliorate the worst effects of climate change on water resources and sustainable development. However, once seriously damaged, recovering groundwater resources requires vast amounts of funds and time.

Stresses on groundwater have been increasing in Asia due to population growth and economic development, and groundwater management already faces critical implementation challenges. Climate change will add greater pressure on the resource, jeopardise sustainability, and intensify inter-sectoral and international conflicts over water, if appropriate adaptation strategies are not implemented. Structural adaptation measures (such as promoting water harvesting and conservation technologies) and institutional adaptation strategies (such as promoting local groundwater management) should be incorporated into comprehensive water management plans.

The impact of climate change on groundwater resources and adaptation opportunities provide a new agenda for water management. To fill the knowledge gaps and reduce uncertainty regarding the predictions and impacts of climate change on groundwater resources and future groundwater management options, more research is needed. Priority research topics include downscaling studies of global climate change models and assessment of current groundwater management structures and institutions.

Some key messages derived from the study to date include:

- (i) Existing water management institutions, policies and water infrastructure in Asia have not been successful in coping with current groundwater problems, so extra effort will be needed to counter the additional negative effects of climate change;
- (ii) Measures to cope with current groundwater stress and potential impacts of climate change include conserving and increasing groundwater storage and diversifying water sources to minimise the risk of water shortages;
- (iii) Rainwater harvesting structures for groundwater recharge and for domestic and agricultural use is a feasible structural adaptation option but new policies to promote rainwater harvesting need to be developed;
- (iv) Institutional adaptation should be promoted, including enhancement of groundwater governance and strengthened local groundwater management. Groundwater management policies can be made more effective by raising local awareness;
- (v) Innovative funding, like the Adaptation Fund, should be used to strengthen institutions, build capacity, educate the public and conduct research on the effects of climate change on groundwater resources; and
- (vi) Extensive research at local scales is needed to reduce the knowledge gap regarding the potential impact of climate change on groundwater resources. This information will help to formulate policies to counteract the impacts of climate change.

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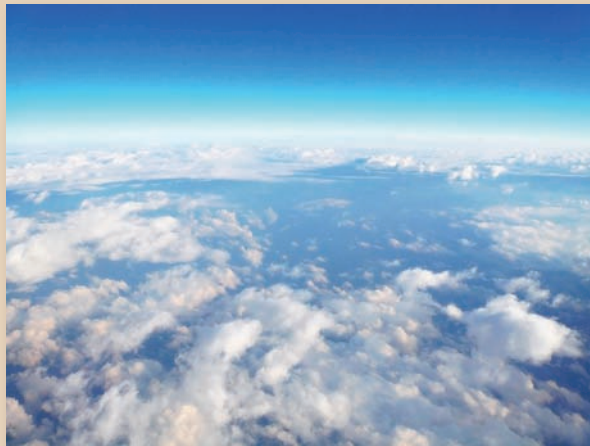
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| CHAPTER 8 |

INSTITUTIONAL CHANGES IN ASIA
IN RESPONSE TO CLIMATE CHANGE



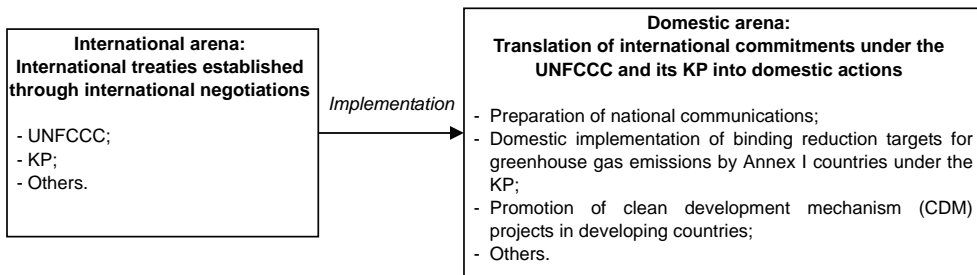
Chapter 8

Institutional Changes in Asia in Response to Climate Change

1. Introduction

Climate change is a complicated issue pertaining not only to the environment and science, but also to economics, politics and diplomacy. To address this global issue effectively requires international cooperation, domestic actions, integration across economic sectors, and the participation of multiple stakeholders and grassroots changes in human behaviour. The current global climate regime includes two correlated processes (fig. 8.1). One is to create international treaties, such as the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP), through international negotiations. The other is domestic implementation of UNFCCC and the KP by translating international commitments into concrete domestic actions to change the behaviour of target groups.

Figure 8.1. International and domestic levels of global climate regime



In response to both processes, many countries in Asia are building domestic institutions. By structuring the relationships among domestic actors and influencing their preferences in dealing with climate change, domestic institutions are important because they influence how countries implement international treaties. They also can influence the effectiveness of international efforts that alter domestic policy priorities and regulations (Kanie et al. 2004). This chapter examines national inter-agency coordination mechanisms (IACM) established to coordinate the functions of various government agencies in response to climate change, at both international and domestic levels. Several factors contribute to differing IACMs across countries such as (i) different international commitments under UNFCCC according to differentiated responsibilities and respective capabilities; (ii) varying contributions to current global greenhouse gas (GHG) emissions and therefore

different international pressures for commitment; (iii) domestic economic factors, *inter alia*, level of economic development, energy supply and mix, industrial structure, energy efficiency, energy consumption, and economy-wide impacts associated with the reduction of GHG emissions and costs to adapt to the impacts of climate change; and (iv) domestic political factors such as bureaucratic arrangements and power sharing among agencies. These factors combine to influence institutional responses to climate change, which, in turn, influence the outcomes of domestic implementation efforts.

In addition, national governments alone cannot address climate change effectively. Participation of other stakeholders, especially local governments, private sector, civil society and academia, in domestic decision making and implementation is important. Under each IACM, different countries use different measures to empower these other stakeholders to play specific roles according to social, economic and political circumstances, which may also influence the outcomes of domestic actions.

This chapter examines the evolution of IACMs in Asia and provides policy recommendations for improving their effectiveness. It focuses on (i) the structure and function of an IACM; (ii) agencies and their specific roles in IACMs; (iii) changes in IACMs and reasons for such changes; and (iv) measures to empower stakeholder participation. Five Asian countries were selected as case studies (table 8.1). Japan, the Republic of Korea (ROK), China, India and the Philippines represent different types of countries represented in the UNFCCC. Japan is the only Annex I country in Asia. China and India are the largest developing nations and are among the biggest emitters of GHGs in the world. Though a non-Annex I country, the ROK is a contrast with other developing nations due to its advanced economy and membership in the Organisation for Economic Cooperation and Development (OECD). The Philippines is considered representative of an average developing country facing daunting financial, technical and human constraints in dealing with climate change. Policy recommendations, based on success factors drawn from comparative study, are provided to improve the performance of IACMs in Asia. The objective is to identify successful practices in Asia that can be emulated by other governments considering reform of their own domestic institutions in response to climate change.

Table 8.1. Country profiles

Item	Japan	The ROK	China	India	The Philippines
Population (million -2007)	127.8 ¹ (12)	48.5 ² (26)	1,321.5 ² (1)	1,119.5 ³ (2)	88.7 ¹ (14)
GDP ⁴ (nominal in millions current \$ - 2006)	4,367.5 (2)	888.3 (12)	2,630.1 (4)	886.9 (13)	117 (47)
GDP ⁴ per capita (nominal in current \$ -2006)	34,188 (19)	18,392 (34)	2,001 (107)	797 (133)	1,345 (118)
Total GHG emissions ⁵ (million tonnes of CO ₂ equivalent-2005)	1,230.36 (5)	499.63 (10)	5,322.69 (2)	1,165.72 (6)	78.06 (46)
GHG emissions per capita ⁵ (tonnes of CO ₂ equivalent-2005)	9.65 (46)	10.27 (39)	4.07 (87)	1.07 (140)	0.89 (150)

Note: Number in bracket indicates world ranking for each country.

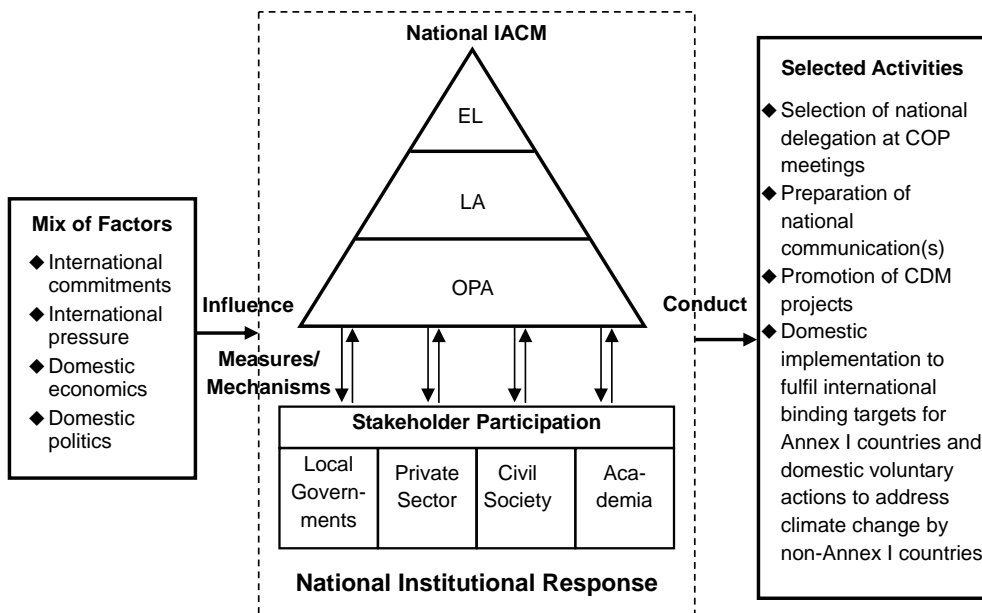
1. Official statistics bureau; 2. Official population clock; 3. UN estimate; 4. International Monetary Fund;
5. Energy Information Administration of the United States (USEIA 2007).

Section two introduces the analytical framework for IACM arrangements. Section three summarises the five country cases, followed by a comparative study in Section four. Conclusions, policy recommendations and a future research agenda are provided in Section five.

2. Analytical framework

An analytical framework was used to examine national IACMs in terms of structure and function, division of responsibilities among relevant agencies and participation of other stakeholders (fig. 8.2). First an IACM is structured into three hierarchical strata: executive leadership (EL), leading agencies (LA) and other participating agencies (OPA). The EL represents the President/Prime Minister (or representatives on his/her behalf) executing overall coordination. The LAs include agencies playing principal roles in domestic decision-making and implementation related to climate change. The OPAs represent other agencies responsible for sectoral actions within their normal functional domains.

Figure 8.2. Structured analytical framework



Note: EL=executive leadership, LA=leading agency, OPA=other participating agency.

Second, other stakeholders in this chapter include local governments, the private sector, civil society and academia, empowered to play specific roles in domestic activities related to climate change. Local governments oversee planning processes, establish local policies and regulations, initiate local programmes and projects, and

assist in implementing national policies related to climate change. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to make grassroots changes in human behaviour. The private sector, including business and industry, contributes to national prosperity and provides major employment and livelihood opportunities. However, they are also responsible for the generation of wastes that impact on human health and the environment, and the manufacture of products that are difficult to recycle. To reduce GHG emissions, they are expected to play a crucial role by improving production systems with technologies and processes that utilise energy and other resources more efficiently and at the same time produce less wastes and GHG emissions—achieving more with less. Civil society, largely comprised of domestic nongovernmental organisations (NGO), play a vital role in the shaping and implementation of participatory democracy (Agenda 21 1992). They can act as a lobby or pressure group, assist in monitoring policy implementation, and enhance global environmental governance by increasing its transparency and accountability (Mori 2004). Academia can provide the scientific information and science and technology know-how that policymakers need in strategic policy and programme formulation. Participation of other stakeholders in an IACM and related activities, directly or indirectly, is assumed to be beneficial to IACMs.

Measures and mechanisms are examined to compare how countries empower the participation of other stakeholders and their interactions with the IACM. Such measures and mechanisms may include (i) direct representation of other stakeholders in the IACM or consultation mechanisms established under the IACM to enable the participation of various stakeholders; (ii) laws and regulations related to climate change, which define the roles and responsibilities of relevant stakeholders and regulate the behaviour of target groups; (iii) local autonomy to establish and implement local policies and programmes related to climate change; (iv) economic and financial incentives for changing production and consumption behaviour; (v) a scientific and technology research fund provided by the government; and (vi) voluntary measures for the reduction of GHG emissions by the private sector, among others.

Third, a mix of factors, *inter alia*, international commitments, international pressure, domestic economics and domestic politics, are considered to explain changes in domestic institutions over time, and differences among countries.

Fourth, to facilitate comparative study, four selected activities are examined in which the IACM together with other domestic stakeholders are involved, *viz.* (i) selection of national delegations at various meetings of the Conference of the Parties (COP) to the UNFCCC; (ii) preparation of national communications (NC) to the UNFCCC; (iii) promotion of clean development mechanism (CDM) projects; and (iv) domestic implementation to fulfil international binding reduction targets by Annex I countries and other domestic actions by non-Annex I countries to address climate change.

To ensure effective and efficient coordination among government agencies in policy-making, facilitate coherent actions, and oversee their implementation, leadership in the national IACM is important. The President/Prime Minister (or representatives on his/her behalf), with power higher than sector ministers, should function effectively as the EL. Since mitigation and adaptation are two major strands of domestic actions in accordance with the UNFCCC and its KP, government agencies with administrative functions related to mitigation and adaptation should be empowered to play key roles in the IACM. For most countries, ministries of industry/energy and environment have such

functions and should be empowered as LAs. As climate change cuts across almost all sectors, the involvement of various sectors in IACM to mobilise sectoral actions will ensure effectively coordinated decision-making and implementation. To promote grassroots change in behaviour of target groups and ensure participatory policy-making and effective implementation, other stakeholders need to be mobilised.

The hypothesis of this chapter is that an ideal IACM will feature (i) strong overall coordination by the EL; (ii) shared responsibilities between ministries of industry/energy and environment as LAs coordinating mitigation and adaptation; (iii) involvement of various sectoral agencies (as OPAs), especially those with major contributions to national GHG emissions or significantly affected by climate change and are expected to take adaptation measures; and (iv) effective mechanisms to empower participation of other stakeholders. Countries will progressively move toward this ideal modality as responsibilities for climate change response evolve.

All data and secondary information used in this study are from the internet, reviews of literature, and specific interviews conducted in the ROK and India.

3. Country case studies

3.1. Japan

Japan is the second largest economy in the world. Total GHG emissions in 2005 amounted to 1.23 billion tonnes carbon dioxide equivalent (tCO₂e), making Japan the world's fifth largest emitter (USEIA 2007). Having ratified the KP as an Annex 1 party, Japan is obliged to reduce GHG emissions by 6% below the base year, 1990, during the first commitment period, 2008-2012. Under the KP, three flexible mechanisms help Annex 1 countries to comply with their obligations: joint implementation (JI), emissions trading (ET), and the CDM.

3.1.1. Evolution of national IACM

The first Meeting of the Council of Ministers for Global Environmental Conservation (MCMGEC) was held in 1989, an *ad hoc* ministers' meeting, which served as a forum to coordinate policies on global environmental issues including climate change (table 8.2). The meeting marked the initiation of an institutional structure at the national government level to deal with climate change.

Table 8.2. Evolution of IACM in Japan

	MCMGEC (1989)	GWPH (1997)
Driving forces	Rising interest and concerns on global environmental issues among industrialised countries around 1989.	Need to deliver a single unified Japanese position to the COP3 in Kyoto, Japan in December 1997.
Legal basis for creation	Decision by the Cabinet.	Decision by the Cabinet in 1997. Re-established in 2005 based on the Law (1998).
EL	Chaired by the Prime Minister (PM) although coordination role by the PM is limited.	Although chaired by the PM, his coordination is still limited.
LAs	None.	Vice-chaired by MOE and METI.
OPAs	All ministries.	All other ministries.
Mandates/ functions	Coordination of policies regarding global environmental issues including climate change.	Overall coordination of promotion, planning, and implementation of measures to cope with global warming.
Frequency of meetings	Inter-ministerial level: 1-3 times per year; working level: more frequent, as appropriate.	Inter-ministerial level: 1-3 times per year; working level: more frequent, as appropriate.
Salient features	Bottom-up policy formulation process, starting from involved ministries to the Council level.	Following deliberations with pertinent ministries, GWPH has final authority on adoption of policies and measures.

Note: EL=executive leadership, LA=leading agency, OPA=other participating agency, MCMGEC=Meeting of the Council of Ministers for Global Environmental Conservation, GWPH=Global Warming Prevention Headquarters, MOE=Ministry of Environment, METI=Ministry of Economy, Trade and Industry.

In 1997, pursuant to a Cabinet decision, the Global Warming Prevention Headquarters (GWPH), an inter-ministerial council, was established. The GWPH is mandated to coordinate strategies relating to organisational setup, policy formulation, and guidelines and action plans on climate change. The GWPH is chaired by the Prime Minister and vice-chaired by the Chief Cabinet Secretary, Minister of Environment, and Minister of Economy, Trade and Industry. All other ministers are also members of the GWPH, although the Minister of Justice and Minister of Labour were not members at its initiation in 1997. Since the Japanese national policy formulation process is bottom-up from the ministries, there have been no top-down measures by the MCMGEC or the GWPH such as allocation of targets and burdens after discussion in the inter-ministerial meeting. In October 2007, the Government of Japan also set up a seven ministers' meeting (Minister of Foreign Affairs, Minister of Finance, Minister of Agriculture, Forestry and Fisheries, Minister of Economy, Trade and Industry, Minister of Land, Infrastructure and Transport, Minister of Environment, and the Chief Cabinet Secretary) on domestic measures for global warming prevention to discuss revision of measures to achieve the reduction target set by the KP commitment. Moreover, the Prime Minister's office established an Advisory Panel on Climate Change in February 2008 to discuss various issues regarding the pathways to develop a low-carbon society and Japan's contribution to the global community. The panel comprises 12 experts from various fields including the industrial sector, NGOs, academia and local governments (Japan for Sustainability 2008).

In 1998, the *Law Concerning the Promotion of Measures to Cope with Global Warming* (the Law) was promulgated to determine the national framework to cope with global warming. Subsequently, *Guidelines for Measures to Prevent Global Warming* (the Guidelines) was formulated to provide concrete policies and measures to achieve the KP targets. In the same year, the *Law Concerning the Rational Use of Energy* was

revised. In 2003, the *Renewable Portfolio Standard Law* was put into force to promote the supply of the electricity generated from renewable energy. In 2005, the *Kyoto Protocol Target Achievement Plan* (the Plan) was formulated. There are also other laws which are not necessarily formulated or revised mainly to cope with climate change, but are listed as measures to achieve the Plan targets.

Formulation of the Guidelines and the Plan began with a draft prepared by the concerned ministries. The drafts were discussed in government councils, with the lead taken by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Environment (MOE) and open to the public including the media. Following these public hearings, the GWPH Steering Committee then drafted the final Guidelines, and coordinated publication. For the Plan, however, the Cabinet approved and published it, in accordance with the Law (1998).

The Japan Council for Sustainable Development was established in 1996 as a multi-stakeholder forum for the national and local governments, industry and business, and civil society organisations, among others, to follow up Agenda 21 and achieve domestic sustainable development. However there is no apparent linkage between the Council and the GWPH.

3.1.2. Stakeholder participation

Following national policies on climate change, all 47 prefectures and several hundred municipalities prepared local action plans on climate change to reduce GHG emissions attributable to the daily operation and maintenance of government offices. In addition, 47 prefectures and several dozen municipalities developed local action programmes to reduce GHG emissions generated in their jurisdiction. However local reduction targets are not explicitly linked with national targets (table 8.3). For local action programmes, 18 prefectures set local targets for GHG emissions reduction higher than the national target, which is 6% reduction in 2010 (base year 1990). Fourteen prefectures set their targets lower than 6% and another 14 prefectures set 6% reduction of GHG emissions as their target. One prefecture set its target based on per capita reduction of GHG emissions rather than total reduction in emissions.

The role of the private sector in Japan is significant and rather unique in its reaction to climate change. In 1997, the Nippon Keidanren (Japan Federation of Economic Organisations) prepared an Environment Voluntary Action Programme which outlines various business initiatives to cope with climate change and improve waste management. As of February 2008, 61 business organisations participate in the programme and each has set targets on energy intensity improvement or annual reduction of GHG emissions. Progress in most business organisations is self-reviewed annually and then reported to the government councils for their review, pursuant to the Guidelines (1998). There is also significant industry representation in government councils established by various ministries, especially in the council hosted by METI. In addition to the actions under the voluntary programme, companies also try to address climate change through corporate social responsibility (CSR) activities, as illustrated by Toyota Motor Company's support of forest plantations.

Table 8.3. Actors in selected activities related to climate change in Japan

Activities	Actors and their roles
Selection of national delegation at COPs	MOFA decides on the composition of official delegation; most participants from MOE, METI, MOFA, MOAFF and MOLIT; no representatives from local governments, private sector and civil society but some from academia.
Preparation of national communications (NC)	MOE coordinated contribution of ministries; MOFA submitted four NCs to UNFCCC Secretariat (1994, 1997, 2002 and 2006); GHG inventory prepared by GHG Inventory Office of Japan and NIES under supervision of MOE while METI, MOLIT, MOAFF, MOE and MOSWL provided data; local governments and industrial associations of electricity, coal, cement, steel and paper sectors provided data for GHG inventory; Japanese individuals and organisations submitted public comments on draft NCs.
Promotion of CDM projects	The Liaison Committee for the Utilisation of the Kyoto Mechanism is the DNA. Project documents submitted to the Liaison Committee are appraised by several ministries according to their jurisdiction: e.g. energy related projects go to METI while "sinks" projects go to MOAFF. MOE and METI designated the New Energy and Industrial Technology Development Organisation (NEDO) to purchase Kyoto credits on the country's behalf through emission reductions purchase agreements (ERPA). Energy, manufacturing and trade companies are actively involved as project developers. Power companies and other private companies have participated in the Prototype Carbon Fund of the World Bank and Japan GHG Reduction Fund in partnership with government financial institutions. As of February 2008, 275 projects were approved by the DNA, with an estimated reduction of 198 million tCO ₂ e/yr; major host countries: China (43.4%), Brazil (8.7%) and India (7.3%); 123 projects were registered by the Executive Board of the Clean Development Mechanism (CDM-EB).
Domestic implementation of international binding reduction target for GHG emissions	Major national policies include (i) <i>Law Concerning the Promotion of Measures to Cope with Global Warming</i> ; (ii) <i>Law Concerning the Rational Use of Energy</i> (revised in 1998); (iii) <i>Guidelines for Measures to Prevent Global Warming</i> , and (iv) <i>Kyoto Protocol Target Achievement Plan</i> . Local action plans for the reduction of GHG emissions from government offices were developed by all 47 prefectures and 663 municipalities out of 1,821. As of March 2006, local action programmes for the reduction of local GHG emissions were developed by all prefectures and 60 municipalities. Civil society, including academia, has been involved in policy-making process at local levels. Japan Centre for Climate Change Action and its prefectural centres partner in local implementation. The major business association, the Nippon Keidanren, developed voluntary emissions reduction programmes. Academia contributed to policy formulation through government councils while other civil society members have been involved in local environmental education initiatives. In 2005, GHG emissions were 7.8% higher than 1990 though the target is a 6% reduction; industry reduced emissions by 5.5% while transport, commercial and residential sector emissions increased by 18.1%, 44.6%, and 36.7%, respectively.

Note: MOFA=Ministry of Foreign Affairs, MOAFF=Ministry of Agriculture, Forestry and Fisheries, MOLIT=Ministry of Land, Infrastructure and Transport, MOSWL=Ministry of Social Welfare and Labour, NIES=National Institute for Environmental Studies, DNA=designated national authority.

Researchers in academia have been significantly involved in policy formulation through participation in government councils and, in particular, in the council under MOE. A few NGOs contribute to the 40-member council under MOE, and there is one NGO member out of the 29 seats in the council administered under METI. The smaller number of NGOs in Japan compared with the United States or European countries, especially those which are providing policy advice to governments at various levels, might contribute to the comparatively limited role that NGOs play in domestic policy-making on climate change. Nevertheless, civil society has contributed to local planning and implementation through the activities of the Japan Centre for Climate Change Action and its prefectural centres.

3.2. The Republic of Korea

The ROK ranks 12th (2006), 10th (2005) and 39th (2005) in terms of GDP, total GHG emissions and GHG emissions per capita, respectively, in the world (IMF 2007; UNSD 2007; USEIA 2007). Energy and manufacturing account for 94.3% of total GHG emissions. As one of world's top emitters with OECD membership but a non-Annex I party, the ROK has been under growing international pressure to make a binding GHG reduction commitment. Energy security and corporate competitiveness are major national concerns, among others, related to climate change.

3.2.1. Evolution of national IACM

In response to the Rio Summit, the Ministerial Committee on Global Environment was established in 1992, covering various topics including climate change.¹ Global environmental issues had been treated as separate issues by corresponding ministries. Since its establishment, there had been no urgent issue for the Committee to call upon an inter-ministerial meeting. This Committee was then abolished in 1996. However, after the adoption of the KP in 1997, the ROK recognised the economic implications of the KP and saw an urgent need to set up a separate national institution to deal with climate change. In April 1998, the Inter-Ministerial Committee (IMC) on UNFCCC (table 8.4) was established, chaired by the Prime Minister. The IMC has four levels: ministers (12), vice-ministers (12), directors-general (DG), and five task forces (negotiation, energy/industry, environment, agriculture and forestry, and research and development [R&D]). The IMC is supported by an expert pool including nine government-affiliated institutes and others. The IMC was expanded in September 2001 to include a new Task Force on General Coordination led by the Office for Government Policy Coordination (OGPC), a ministerial-level body assisting the Prime Minister in policy coordination, evaluation and regulatory reform. The IMC will be restructured in 2008 to remove the duplication of the vice-ministers' working council and to further strengthen the OGPC in overall coordination. The task forces are now streamlined into four areas to implement the fourth national action plan (NAP): negotiation, mitigation, adaptation, and R&D.

In addition, a Presidential Commission on Sustainable Development (PCSD), a standing body that provides advice to the President, was established in 2000 based on the political philosophy and management of government affairs during the presidency of Kim Dae Jung (1998-2002). The PCSD has a broader scope and function than the IMC and, perhaps illogically, works independently from it. The new President, Lee Myung Bak, took office in December 2007. The new government has emphasised turning the climate change crisis into an opportunity for national economic growth. This indicates that the response of the new government to climate change may be more proactive. So far, however, there has been no change in national institutional arrangements related to climate change.

Table 8.4. Evolution of IACM in the ROK

	IMC (1998)	IMC (2008)
Driving forces	Kyoto Protocol; implementation of first national action plan (NAP) (1999-2001).	Implementation of fourth NAP (2008-2012).
Legal basis for creation	Prime Minister's Order.	Prime Minister's Order.
EL	Prime Minister as chair and OGPC providing overall coordination.	Prime Minister and OGPC providing overall coordination.
LAs	MOCIE, MOE and MOFAT are lead agencies in energy/industry, environment and negotiations; MOCIE plays key role.	MOCIE, MOE, MOFAT and KMA are lead agencies in four priority areas: mitigation, adaptation, negotiation, and R&D.
OPAs	Includes finance, public affairs, science & technology, agriculture & forestry, construction, maritime affairs, planning & budget, and information agencies.	N/A.
Mandates/ functions	To (i) make consistent climate policies (ii) minimise negative impacts of UNFCCC on Korea's economy and develop diverse negotiation strategies (iii) promote concrete measures on mitigation and (iv) implement NAPs.	In addition to existing mandates, to establish an integrative responsive mechanism of mitigation and adaptation.
Frequency of meetings	Ministerial level and vice-ministerial level: once every three years; DG level: once a month.	N/A.
Salient features	Complicated hierarchical structure with a supportive expert pool.	Involvement of local governments.

Note: EL=executive leadership, LA=leading agency, OPA=other participating agency, NAP=national action plan, OGPC=Office for Government Policy Coordination, MOCIE=Ministry of Commerce, Industry and Energy, MOE=Ministry of Environment, MOFAT=Ministry of Foreign Affairs and Trade, KMA=Korea Meteorological Administration, N/A=not available, DG=director-general.

3.2.2. Stakeholder participation

To date, local governments (table 8.5) have played a limited role in climate related activities in the ROK, although they have been actively involved in the promotion of local sustainable development. In 2003 all 16 regional governments and 164 out of 232 local governments developed their Local Agenda 21 (Korean Council for Local Agenda 21 2008). Domestic activities related to climate change have been initiated by the national government and the major role of local governments is delivering national policies into their localities. This may be partly due to a long history of strong national government in the ROK and a relatively short history of local autonomy. Nevertheless, local governments have put great effort into energy policies and transportation issues though not necessarily linked with climate change. Recently local governments have recognised the importance of climate change policies and are trying to develop concrete action plans in response to climate change. During the IMC restructuring in 2008, a Conference of Local Governments will be established to provide a channel for local government participation in decision-making and in implementation of NAPs.

For the private sector, the Industrial Committee on Measures for the UNFCCC was established in 2001. Industry also contributed to the completion of Korean National Communications by establishing a GHG database and providing research funding and technical assistance to the national GHG inventory. The private sector has also developed voluntary agreements in the implementation of NAPs.

Table 8.5. Actors in selected activities related to climate change in the ROK

Activities	Actors and their roles
Selection of national delegation at COPs	Three key ministries: MOFAT, MOCIE and MOE; MOE's minister as head of national delegations at COP; MOCIE's Senior Coordinator for Environment and Science as head of national delegations at SBSTA/SBI and MOFAT coordinating and synthesizing national positions; no representation from local government, private sector or civil society; participation of academia, however, has increased dramatically since COP4 with a share of more than 20%.
Preparation of national communications (NC)	OGPC is in charge of NCs but delegated action to KEEI of MOCIE; a research team was organised comprising 7 ministries, 4 government-affiliated institutes and 1 state-owned enterprise; private sector established a GHG database; some companies offered research funding and technical assistance to the national GHG inventory; two NCs submitted to UNFCCC in 1998 and 2003, respectively.
Promotion of CDM projects	DNA is the CDM Review Committee under the IMC, chaired by OGPC with members from foreign affairs, science and technology, agriculture and forestry, environment, public affairs and others. OGPC coordinates the approval process. KEMCO of MOCIE provides technical support to local governments and the private sector for the preparation, implementation and monitoring of CDM projects. As of February 2008, 17 projects were registered by CDM-EB and more than half are unilateral CDM projects. As of December 2007, 41 CDM projects were approved by DNA.
Other domestic voluntary actions related to climate change	Three NAPs (1999-2001, 2002-2004, 2005-2007) prepared and implemented by IMC; agencies initiated project proposals, OGPC screened and coordinated proposals, then ministerial committee of IMC gave final approval of NAPs. Priorities of the 1st and 2nd NAP were (i) system construction in response to the UNFCCC and; (ii) development of technologies and measures on GHG reduction. The 3rd NAP prioritised impact assessment and adaptation; priorities of the 4th NAP are shifting to mitigation and technology development. Local governments were not included in past decision-making processes or in NAPs, but will be included in the 4th NAP (2008-2012). About 36 projects were implemented in 1st NAP, 84 in 2nd NAP and 91 projects in 3rd NAP.

Note: SBSTA=Subsidiary Body for Science and Technology, SBI=Subsidiary Body for Implementation, NC=National Communication(s), KEEI=Korea Economy and Energy Institute, DNA=designated national authority, KEMCO=Korea Energy Management Corporation, CDM-EB=Executive Board of the Clean Development Mechanism, NAP=national action plan.

NGOs play a limited role in climate change responses in the ROK, although they are represented in many environment-related committees. A "Policy Conference for Environmental NGOs" consisting of more than 20 NGOs was established and meets three to four times a year to discuss current environmental issues and policies. The Government provides limited financial support for environmental NGOs and supports a variety of events. However, in the IMC and climate change responses, a Government-NGO consultation mechanism has not been established to date.

Academia plays a very active role in climate related activities. Government-affiliated institutes together with other private institutes form an expert pool to the IMC providing technical support to the Government in the decision-making process. Of the ROK's national delegation at COPs, up to 20% of total delegates came from government-affiliated and other institutes. For the preparation of two national communications, the Korea Energy Economics Institute (KEEI), which is affiliated to the Ministry of Commerce, Industry and Energy (MOCIE), was delegated by the OGPC to organise government agencies and institutes and to coordinate the work.

3.3. China

Attributable to its rapid economic growth since the early 1980s and with the largest population in the world, China became the second largest GHG emitter in 2005. However, 47% of the population still live in poverty (World Bank 2006c) and GHG emissions per capita ranked 87th, less than the world average (USEIA 2007). Playing an important role in the “G77 plus China” and being one of top GHG emitting countries, China has been under pressure from developed countries in the UNFCCC to undertake stronger commitments. In recent years, the Government made a change in development strategy advocating a *Scientific Approach of Development and Building of Resource Conservation and Environmentally Friendly Society*. This may lead to a more proactive attitude to addressing climate change.

3.3.1. Evolution of national IACM

In 1990, China established its first IACM to coordinate participation in IPCC-related work and international negotiations (NCCCC 2007a). The State Meteorological Administration, a weak agency in China’s bureaucratic system, played the leading role together with the Ministry of Foreign Affairs (MOFA). Climate change was perceived primarily as a scientific issue and an issue of international relations.

In 1998, a new IACM, the National Coordination Committee on Climate Change (NCCCC) was established (table 8.6), chaired by the State Development and Planning Commission (SDPC), a macroeconomic management agency above the ministry level. This IACM coordinated climate policies, activities related to climate change and matters related to international negotiations, while significant decisions were made by the State Council. Other lead agencies included foreign affairs, meteorology, science and technology, and the environment. The IACM was expanded in 2003, increasing its members from 7 to 12.

To address change in development approach, climate change and other domestic environmental issues, China set two mandatory domestic targets on energy intensity (20% reduction) and emissions reduction of major pollutants (10%) for 2006-2010 (State Council 2006). In June 2007, to strengthen implementation, the State Council established an inter-ministerial leading group, chaired by the Premier (State Council 2007). This IACM has external functions related to the UNFCCC and internal functions related to domestic implementation of the two targets. Externally, the National Development and Reform Commission (NDRC, successor of SDPC) is the lead agency, together with foreign affairs, science and technology, environment and meteorology agencies. For internal functions, the NDRC and the State Environmental Protection Administration (SEPA, since March 2008, upgraded to Ministry of Environmental Protection) are the leading agencies coordinating energy conservation and emissions reduction, respectively. Potential changes in the new ministry’s responsibilities in the national IACM were not yet available when writing this chapter.

China has not established a national council on sustainable development. However, the State Council delegated relevant responsibilities to the NDRC and the Ministry of Science and Technology (MOST) as two lead agencies coordinating other agencies in activities related to sustainable development. On 25 March 1994, the Administrative Centre for China’s Agenda 21 was established, a governmental organisation affiliated to the then State Science and Technology Commission (predecessor of MOST), to be

responsible for implementation of projects under China's Agenda 21. Although the NDRC and MOST are also LAs in the current IACM, the establishment of the climate change IACM and its evolution are separate from national institutional arrangements for sustainable development. How the NDRC and MOST harmonise their functions related to climate change and sustainable development within each agency needs to be investigated further.

Table 8.6. Evolution of IACM in China

	NCCCC (1998)	NCCLG/NECERLG (2007)
Driving forces	(i) Government restructuring in 1998; and (ii) need to strengthen coordination by replacing SMA by the SDPC.	(i) Increasing international pressure; (ii) political change in development strategy; and (iii) need to strengthen integrated implementation of two domestic mandatory targets.
Legal basis for creation	State Council Notification during government restructure in 1998.	State Council Notification No.18 (2007)
EL	No representation from the State Council.	Premier as chair, Vice Premier and State Councillor as vice-chairs.
LAs	Executive Office at the SDPC with SDPC as Chair; MOFA, CMA, MOST, SEPA* and MOF coordinating five specific areas: (i) COP delegation; (ii) IPCC participation; (iii) implementation of CDM; (iv) EIA; and (v) GEF-related work.	Executive Office at NDRC; external function related to the UNFCCC: led by the NDRC with MOFA, MOST, SEPA and CMA; internal function on energy conservation and emissions reduction: led by the NDRC and SEPA.
OPAs	Seven agencies: economy and trade, construction, water resources, transportation and communication, academy of science, forestry, and maritime affairs.	Another 22 agencies.
Mandates/ functions	To (i) improve China's capacity to implement the UNFCCC; (ii) contribute to China's sustainable development; (iii) frame national interests in negotiations; and (iv) build consensus in climate policy making among agencies.	To (i) study and draft significant national strategies, principles and countermeasures addressing climate change; (ii) study and review China's strategy for international negotiations; and (iii) implement energy conservation and emissions reduction.
Frequency of meetings	Twice a year before and after each COP (Bjørkum 2005).	No available—one meeting chaired by the Premier in July 2007 after its creation in June 2007 (NDRC 2007).
Salient features	Stronger and more stable than previous mechanism, led by powerful macroeconomic agency with distinct division of responsibilities among agencies; role of SEPA is insignificant.	Stronger overall coordination led by the Premier emphasizing the implementation and enforcement of domestic mandatory targets.

* SEPA was upgraded to ministerial level in March 2008, titled the Ministry of Environmental Protection.

Note: EL=executive leadership, LA=leading agency, OPA=other participating agency, NCCCC=National Coordination Committee on Climate Change, NCCLG/NECERLG=National Climate Change Leading Group/National Energy Conservation and Emission Reduction Leading Group, SMA=State Meteorological Administration, SDPC=State Development and Planning Commission, MOFA=Ministry of Foreign Affairs, CMA=China Meteorological Administration (successor of SMA), MOST=Ministry of Science and Technology, SEPA=State Environmental Protection Administration, MOF=Ministry of Finance, NDRC=National Development and Reform Commission, EIA=environmental impact assessment.

3.3.2. Stakeholder participation

In accordance with the national directive, provincial governments have issued local regulations and a few of them set up provincial inter-agency coordination mechanisms, with similar composition to the national IACM (table 8.7) (NCCCC 2007b). To enforce implementation of the two mandatory targets, the Government established a target responsibility system and performance assessment system. Local governments at each level (province, county and township) signed the target-responsibility agreement with their higher tier government and their performance is inspected and assessed annually. The results have been used to evaluate the political performance of local governors. CDM promotion centres have been established in 22 provinces to support the preparation of project design documents and provide relevant training (Kyoto Mechanisms Information Platform 2007).

Table 8.7. Actors in selected activities related to climate change in China

Activities	Actors and their roles
Selection of national delegation at COPs	NDRC, MOFA and MOST are playing the more important roles in cooperation with CMA, SEPA*, MOA and SFA. Majority from NDRC but MOFA leads and coordinates negotiations; MOST with increasing role related to CDM; no representatives from local government, private sector, or civil society, but academia increased sharply since COP6 (more than 35%).
Preparation of national communications (NC)	Project Steering Committee established by IACM including NDRC, MOFA, MOST, MOF, SEPA and CMA; Executive Office, along with Project Management Office at NDRC; local governments and private sector with limited participation in GHG inventory project; no participation from civil society; six government-affiliated research institutes joined national GHG inventory project; initial NC submitted by IACM in December 2004.
Promotion of CDM projects	IACM coordinates CDM policies. NDRC as DNA gives final approval of projects. CDM Board under IACM include NDRC and MOST as co-chairs, MOFA as vice-chair and SEPA, CMA, MOF and MOA as members, responsible for the review of projects while "Measures for the Operation and Management of Clean Development Mechanism Projects" was issued jointly by NDRC, MOST, MOFA and MOF, based on which a levy system on CERs was established to promote projects on (i) energy efficiency; (ii) new and renewable energy; and (iii) methane recovery and utilisation. China CDM Fund was set up with Management Centre at MOF in August 2006. CDM promotion centres in 22 provinces established. Experts and institutes provide technical support in the CDM review process. By February 2008, 162 projects were registered by CDM-EB, 28 projects obtained CERs and 1,113 projects were approved by DNA.
Other domestic voluntary actions related to climate change	Major measures adopted by the Government: (i) legislation, national and sectoral plans and programmes, including the National Climate Change Programme to provide guidance and set targets for priority areas; (ii) enforcement of two mandatory targets providing 40 measures, including financial mechanisms, such as energy conservation criteria for obtaining loans and pricing system for renewable energy; and (iii) target responsibility system; national mandatory targets divided into local targets. Provincial governments issued local regulations, developed action plans and set up implementation institutions. NDRC signed target responsibility agreements with 1,000 energy intensive enterprises to enforce energy conservation in 2006. Among other activities, eight environmental NGOs published a report on actions for combating climate change. Forty NGOs launched "20% Energy Saving Citizen Actions" in 2007 to raise public awareness. Academia promotes energy saving R&D, monitoring and observation infrastructure and fostering human resources.

* SEPA was upgraded to ministerial level in March 2008, titled the Ministry of Environmental Protection.

Note: NDRC=National Development and Reform Commission, MOFA=Ministry of Foreign Affairs, CMA=China Meteorological Administration, MOST=Ministry of Science and Technology, SEPA=State Environmental Protection Administration, MOF=Ministry of Finance, SFA=State Forestry Administration, MOA=Ministry of Agriculture, DNA=designated national authority, CER=certified emission reduction, CDM-EB=Executive Board of the Clean Development Mechanism.

The private sector accounts for 70% of national energy consumption (NDRC and NBSC 2007). The mandatory targets are disaggregated into sectoral and local targets and further into the targets of major energy-intensive enterprises and large emitters. The NDRC selected 1,000 enterprises, whose energy consumption accounted for 50% of total industrial energy consumption and, in 2006, signed target responsibility agreements with them.

In general, independent civil society in China is weaker compared with the other four countries examined here. However, civil society groups working in the area of the environment are more active than in other areas. The challenges of climate change have aroused the attention of China's civil society groups but so far they have not played a major role. A few domestic NGOs and local offices of international NGOs have carried out various projects to address climate change and participated in UNFCCC meetings (NCCCC 2007c).

Academia, especially government-affiliated institutes, plays an active role in most climate-related activities (MOST et al. 2007). Academic institutes have made significant contributions including (i) one third of the national delegation at COPs and preparation of negotiation positions; (ii) climate change R&D; (iii) IPCC related work (including four Assessment Reports); (iv) pilot stage of implementing CDM and review of CDM projects for domestic approval; and (v) preparation of national communications.

3.4. India

At 1.1 billion, India ranks second in world population, with an annual average population growth rate of 1.7% (World Bank 2007). From a total land area of 3.28 million square kilometres, 61% is used for agriculture. In 2006, GDP was \$886.9 billion (IMF 2007) with an annual growth rate of 8.4% (World Bank 2006). With emissions measured at 1.07 tCO₂e/cap (USEIA 2007), India ranked sixth among the largest global emitters of GHGs in 2005. In spite of being one of the ten fastest-growing economies in the world, per capita GDP remains one of the lowest with about one-fourth of India's population below the poverty line. Only 55% of Indian households have access to electricity (Ray 2007). With a high population density, India is vulnerable to climate change impacts, especially in coastal areas. As a non-Annex 1 party to the UNFCCC, it is only required to submit NCs. Based on the 1994 GHG Inventory, CO₂ accounts for 65% of total GHG emissions, and the energy sector accounts for almost two-thirds of CO₂ emissions (MOEF 2004).

3.4.1. Institutional arrangement

The Ministry of Environment and Forests (MOEF) is responsible for planning, promotion, coordination, and overseeing implementation of environment and forestry policies and programmes. The National Environment Council—chaired by the Prime Minister with members including senior representatives of central ministries, chief ministers of states, representatives of NGO groups, and distinguished scientists and academics—is the highest policy-making body on environmental issues (UN DESA 2007). Prior to 2007, India had not set up an IACM comparable with other countries in this study (table 8.8). A Climate Change Division within MOEF carried out the function of the DNA for the CDM and various sectoral plans and programs on both adaptation and mitigation initiatives were also adopted and implemented. However, before the G-8

Summit and on World Environment Day in June 2007, the Government announced the establishment of a Prime Minister's Council on Climate Change (PMCCC) (MOEF and MOP 2007). The PMCCC is comprised of official and non-official members. Additionally, in March 2008 the Prime Minister announced that a permanent negotiating team is to be created within the PMCCC (The Indian Express 2008).

Poverty reduction and economic growth are the prime objectives of India's national development strategy. These objectives have been consistently emphasised in the country's successive five-year plans (FYP), which provide the medium-term strategies for overall development and are prepared by the Planning Commission of India under the overall guidance of the National Development Council. To support economic growth under the 10th FYP (2002-2007), India has focused on energy supply and improving access to clean and modern fuels. India's economy has grown at a rate of over 9% per year but energy intensity has been reduced since 2004. The Government intends to further improve these areas by promoting sustainable patterns of consumption, enhancing competitiveness, promoting energy efficiency, and using CDM to promote clean energy technologies (MOEF and MOP 2007).

Table 8.8. Creation of IACM in India

	Prime Minister's Council on Climate Change (2007)
Driving Forces	The need for India to review, consolidate and articulate climate change mitigation and adaptation strategies; release of the Fourth IPCC Assessment Report.
Legal basis for creation	Prime Minister's Directive of 7 June 2007 creating a high-level advisory panel on climate change.
EL	Prime Minister's Office.
LAs	MOEF, MOP, and Principal Scientific Advisors to the Prime Minister.
OPAs	MEA, MOST, MA, MWR, MOF, Planning Commission, and private sector through economic councils.
Mandates/ functions	To provide strategic guidance on mainstreaming climate change in development, identify key intervention priorities, and formulate a National Action Plan on Climate Change.
Frequency of meetings	At least 4 times before the COP delegation left for the 2007 COP13 meeting.
Salient features	Multi-stakeholder representation - non-official members include credible personalities from civil society and the mass media.

Note: EL=executive leadership, LA=leading agency, OPA=other participating agency, MOEF=Ministry of Environment and Forests, MOP=Ministry of Power, MEA=Ministry of External Affairs, MOST=Ministry of Science and Technology, MA=Ministry of Agriculture, MWR=Ministry of Water Resources, MOF=Ministry of Finance.

The Eighth Energy Sector Plan (1992-1997) promoted energy conservation, which has contributed to the declining energy intensity of industry and transport sectors. The introduction of the "Bharat 2000" contributed to the upgrading of vehicular emission standards and promoting low or no-carbon emitting vehicles. Introduction of compressed natural gas was a major factor in air quality improvement. In agriculture, standardisation of fuel-efficient pump sets, rationalisation of power tariffs, and better cultivation practices to reduce nitrous oxide emissions were undertaken. In the residential sector, LPG stoves, compact fluorescent lamps, and fuel-efficient pumps for lifting water in high-rise buildings, have been promoted. The Energy Conservation Act 2001 created a Bureau of Energy Efficiency to facilitate and enforce efficient use of energy. Rationalisation of coal use, pricing reforms, technology upgrading, promotion of new and renewable energy forms, promotion of fuel efficiency and conservation

through reduction of gas-flaring, installation of waste-heat recovery systems, energy audits, equipment upgrades, and substitution of diesel with natural gas all contributed to India's mitigation efforts. The Electricity Act, 2003 has led to an acceleration of renewable electricity capacity addition (MOEF and MOP 2007). In 2006, an energy labelling system for appliances was introduced. In 2007, the Energy Conservation Building Code directs the designers of new, large commercial buildings to optimise energy demand.

During the opening address of the Delhi Sustainable Development Summit in February 2008, the Prime Minister of India listed various adaptation measures among the priority areas of the country which include large scale afforestation, drought-proofing, protection of the glacial systems and coastal areas as safeguards against the hazards of climate change (Merinews 2008).

3.4.2. Stakeholder participation

India is the largest democracy in the world; a federal political system with the President as the head of state elected by members of the central and state assemblies for a five-year term. The executive function rests with the Prime Minister who presides over the Council of Ministers. The legislative branch is bicameral, comprised of the House of the People (*Lok Sabha*) and the Council of States (*Rajya Sabha*). With a strong judiciary and Supreme Court, environmental issues in India are of high importance, and are taken up aggressively by the powerful media and an active NGO community. In preparing the first NC, a broad participatory approach was adopted with 131 research teams drawn from research and technical institutions, universities, government departments and NGOs (MOEF 2004) (table 8.9) .

Table 8.9. Actors in selected activities related to climate change in India

Activities	Actors and their roles
Selection of national delegation at COPs	The COP8 meeting in New Delhi ushered in more NGO participation. Research institutions under the environment agencies are usually represented, with other government representatives coming from foreign affairs and sometimes from industry agencies.
Preparation of national communications (NC)	The environment agency takes the lead but local government contributes to data collection. Civil society has mostly contributed to capacity building initiatives.
Promotion of CDM projects	MOEF is the DNA in charge of all matters pertaining to CDM projects, but state governments have established CDM promotional cells to encourage submission of CDM project proposals; the private sector assists in information dissemination on CDM rules; NGOs conduct capacity building, and academia participates in technical evaluation of project concept notes and proposals.
Other domestic voluntary actions related to climate change	At the state level, power sector reform began by transferring tariff fixing powers to independent regulators to encourage private sector participation. Energy agencies mobilise participation of local institutions, NGOs, and village-level organisations to implement non-conventional energy programmes. Private sector participation is encouraged in operation of public transit providers. The Indian Refining Industry has increased use of more efficient equipment and technology. Indian coal companies are planting mined-out areas to contribute to adaptation efforts. On various energy conservation and efficiency programs, NGOs have been actively participating in state assembly forums. Research institutions are engaged in climate science research and modelling.

The Constitution Amendment Act of 1992 ushered in a decentralised approach to development planning. Consequently, under India's 8th FYP (1992-1997) and 9th FYP (1997-2002), social mobilisation and participation of people at all levels were recognised as means to ensure environmental sustainability of the development process (UN DESA 2007). The 10th FYP (2002-2007) on the other hand, paved the way for the formation of what is now popularly known in India as self-help groups.

The states of Andhra Pradesh, Madhya Pradesh and West Bengal have established CDM promotional cells to facilitate submission of CDM project proposals. The private sector has assisted in increasing capacity of Indian industry on issues such as cleaner production options, ISO 14000, green ratings, greening supply chains, environmental legislation and energy auditing. The Federation of Indian Chambers of Commerce and Industry has established an Environmental Information Centre to enable Indian industry to become more environmentally responsible and competitive. NGOs have also played an important role in awareness-raising and in empowering communities and women by facilitating self-help groups at the grassroots level. Research institutions have been active in the outreach component of climate change initiatives in India. Indian scientists have contributed to national and international climate research efforts such as the International Indian Ocean Expedition, Monsoon Experiment, Indian Ocean Experiment, World Climate Research Programme, Global Observing System, and the International Geosphere-Biosphere Programme (MOEF 2004).

3.5. The Philippines

The Philippine archipelago has a land area of 299,764 square kilometres. In 2007, the population was 88.7 million with an average growth rate of 1.9% (NSCB 2007). GDP has been growing steadily from 3.0% in 2001 to 5.1% in 2005 (ADB 2006). Poverty incidence remains high at 33% in 2000 (NSCB 2007). A growing consumer of energy, particularly electric power, the key growth drivers of the economy are attributed mainly to the services sector. Per capita emissions were 0.89 tCO₂e/yr in 2005 (USEIA 2007) and emissions growth was 43% from 1990-2003 (World Bank 2007). Almost 50% of GHG emissions come from the energy sector. In the first national communications to the UNFCCC, the national GHG inventory reported that the Philippines released 100,738 ktCO₂e, associated with four main sectors: energy (49%), industry (11%), agriculture (33%), and land wastes (7%). Being a tropical archipelago, the country is highly vulnerable to the impacts of climate change, particularly for agriculture and food security.

3.5.1. Evolution of national IACM

Even before becoming a party to the UNFCCC, the Philippines created an Inter-Agency Committee on Climate Change (IACCC) to coordinate all climate change related activities (table 8.10). The IACCC facilitated preparation of the country's first NC under the lead of the Department of Environment and Natural Resources (DENR), which was also assigned as the DNA for CDM in 2004.

In 2007, a Presidential Task Force on Climate Change (PTFCC) was established, which in effect replaces the IACCC as the lead coordinating body on climate change matters. Under this new arrangement, the IACCC was made the technical arm of the PTFCC and other agencies have been designated to assist the PTFCC. The PTFCC is

chaired by the DENR. Following its first meeting in June 2007, an Advisory Council to the PTFCC was created, chaired by the DENR Secretary, co-chaired by the Presidential Adviser to Land Reform, and with six members from academia and NGOs. All bureaus and offices of the DENR are required to provide assistance to the Council and the Environment Management Bureau has been instructed to allocate the necessary funding for the Council's operation.

Table 8.10. Evolution of IACM in the Philippines

	IACCC (1991)	PTFCC (February 2007)	Amended PTFCC (August 2007)
Driving forces	Growing international debate and national interest on the issue of environment and development.	Release of Fourth IPCC Assessment Report; increased domestic concern and call from civil society members to address climate change.	Call for greater mitigation strategies in the country's climate change initiatives.
Legal basis for creation	Presidential Administrative Order 220 (8 May 1991).	Presidential Administrative Order 171 (20 February 2007).	Presidential Administrative Order 171-A (15 August 2007).
EL	DENR.	Office of the President.	Office of the President.
LAs	DENR, DOST.	DENR.	DOE.
OPAs	DFA, DOE, NEDA, DPWH, DOTC, PNCC Senate.	DOE, DOST, DILG, DA, two representatives from civil society, and member-agencies of the IACCC as the technical arm of the new PTFCC; an Advisory Council was created co-chaired by the Presidential Adviser on Land Reform with most members from academia.	DENR, DOST, DILG, DA, DepEd, CHED, two representatives from civil society and IACCC member-agencies.
Mandates/ functions	Coordinate climate change-related activities, propose climate change policies, and prepare the Philippine positions to the UNFCCC.	Conduct rapid assessments on climate change impacts; ensure strict compliance to air emission standards; combat deforestation; reduce GHG emissions; conduct comprehensive public information campaign.	Same mandate as the original PTFCC.
Frequency of meetings	Quarterly per annum (Inter-ministerial).	First met in June 2007.	Four meetings before COP13 (Bali, Indonesia).
Salient features	Civil society participation through the PNCC.	Multi-stakeholder participation; added DA, DILG as members; increased involvement of academia through the creation of an Advisory Council.	Transfer of chairmanship from DENR to DOE; added DepEd and CHED as members; multi-stakeholder participation with more involvement of academia.

Note: EL=executive leadership, LA=leading agency, OPA=other participating agency, IACCC=Inter-Agency Committee on Climate Change, PTFCC=Presidential Task Force on Climate Change, DENR=Department of Environment and Natural Resources, DFA=Department of Foreign Affairs, NEDA=National Economic and Development Authority, DPWH=Department of Public Works and Highways, DOTC=Department of Transportation and Communication, PNCC=Philippine Network on Climate Change (civil society organisations), DA=Department of Agriculture, DILG=Department of Interior and Local Government, DA=Department of Agriculture, DepEd=Department of Education, CHED=Commission on Higher Education and Development.

The mandate of the PTFCC includes (i) conducting rapid assessment on the impact of climate change, especially on the most vulnerable sectors; (ii) ensuring strict compliance to air emission standards and combating deforestation and environmental degradation; (iii) undertaking strategic approaches to reduce GHG emissions; (iv) conducting comprehensive public information campaigns on climate change; (v) designing risk reduction and mitigation measures and adaptation responses to climate change; (vi) collaborating with international partners; (vii) integrating and mainstreaming climate risk management in policies, plans and programmes; and (viii) guiding, coordinating and monitoring implementation of a Climate Change Action Plan.

The most notable structural change from the IACCC to the PTFCC was the addition of the Department of Interior and Local Government as a member. Under the 1991 Local Government Code, the role of Local Government Units (LGU) changed with the devolution of five basic services to LGUs, including environmental protection. LGUs are also encouraged to promote local autonomy by facilitating civil society participation.

Six months after creation of the PTFCC, the structure was altered to designate the Secretary, Department of Energy (DOE) as Chair, and the Secretary, DENR as Vice-Chair. Membership of the PTFCC was expanded to include the Department of Education and the Commission on Higher Education and Development. Unlike the IACCC, the PTFCC meets at ministerial level. Two representatives from the Philippine Network on Climate Change, an NGO coalition, have also attended the PTFCC meetings. Four flagship programmes proposed include (i) mitigation; (ii) adaptation; (iii) financing; and (iv) technology and R&D. Funding is intended to be secured by tapping development assistance funds, among others (PTFCC Philippines 2007).

3.5.2. Stakeholder participation

One of the first steps by the Government in the early 1990s was the formulation of the Philippine Strategy for Sustainable Development and Philippine Agenda 21, documenting the partnership of government with NGOs to implement commitments arising from the 1992 Earth Summit. Hence, the IACCC was created with strong civil society representation. For the First NC, academia and grassroots/community organisations provided support in data collection, capacity building, education and training (table 8.11). Passage of the Local Government Code of 1991 assisted in the decentralisation of sustainable development issues through the formation of Local Councils for Sustainable Development (LCSD) set up in each administrative region.

Table 8.11. Actors in selected activities related to climate change in the Philippines

Activities	Actors and their roles
Section of national delegation at COPs	Majority from national government but NGOs are represented in all COP meetings.
Preparation of national communications (NC)	DENR as lead but LGUs assisted and NGOs and academia have participated through representation at LCSDs.
Promotion of CDM projects	DENR as DNA but LGUs lend support; private sector and NGOs are active through the CDM Steering Committee.
Other domestic voluntary actions related to climate change	With the DENR, DOE and DOST taking the lead in implementation; the passage of laws and regulations (addressing mitigation and adaptation strategies) would not have been possible without the advocacy of civil society groups; private sector has collaborated with government in energy efficiency promotion; academia has lobbied for inclusion of environmental education in the school curriculum.

Note: NGO=nongovernmental organisation, DENR=Department of Environment and Natural Resources, LGU=Local Government Unit, DNA=designated national authority, DOE=Department of Energy, DOST=Department of Science and Technology.

The LCSDs have been created to further strengthen the Philippine Council for Sustainable Development, headed by the Director-General of NEDA as Chair, and the Secretary of the DENR as Vice-chair. The Council consists of various departments of the national government and groups from civil society. Created in September 1992, the PCSD is mandated to (i) review and ensure the implementation of Philippine commitments to sustainable development principles made at the 1992 Rio Summit; (ii) establish guidelines and mechanisms to concretise and operationalise the sustainable development principles; (iii) provide directions in the form of policy reforms, programmes, and new legislations to address emerging issues related to environment and sustainable development; (iv) act as a coordinating mechanism, together with the Department of Foreign Affairs; and (v) adopt a Philippine Agenda 21 and national sustainability plans (PCSD Philippines 2007).

Various mitigation and adaptation measures are reflected in sectoral plans, particularly in energy, transport, and agriculture. The Medium Term Philippine Development Plan for 2004-2010 identified priority interventions in five clusters, including energy. The Philippine Energy Plan (2005-2014) emphasises (i) energy independence and savings; and (ii) power sector reforms.

Related legislation includes (i) Philippine Clean Air Act of 1999; (ii) Philippine Ecological Solid Waste Management Act of 2000; (iii) Agricultural and Fisheries Modernisation Act of 1997 (includes monitoring the effects of global climate change and weather disturbances); (iv) Clean Water Act of 2004; and (v) Electric Power Industry Reform Act of 2001 (calling for greater private sector participation and competition to expedite electrification).

4. Comparative study

4.1. National delegations at COPs

Japan has the largest number of delegates at COPs, followed by the ROK and China, with India and the Philippines having smaller delegations (table 8.12). A larger national delegation may indicate a stronger national potential for international negotiations. Direct representation from the executive leadership (EL) in the national delegation from the ROK, China and the Philippines has been observed in a number of COPs and may indicate the keen interest of the EL on specific matters in the agenda of concerned COPs.

Table 8.12. National delegations at COPs

Actors	Japan	The ROK	China	India	The Philippines
EL	X	4%	0.4%	X	2%
LAs	EA (26%) BRA (14%) FA (14%)	EA (16%) BRA (8%) FA (8%)	- BRA (22%) FA (20%)	EA (47%) - FA (3%)	EA (23%) - FA (3%)
OPAs	17%	7%	27%	11%	31%
Local government	X	X	X	3%	X
Private sector	X	X	X	X	X
Civil society	X	X	X	5%	17%
Academia	4%	18%	22%	3%	2%
Diplomatic missions	21%	13%	9%	34%	18%
Average number of delegates	73	32	27	17	13

Note: Percentage represents the average for each actor from COP1 to COP12.

EL=executive leadership, LA=leading agency, OPA=other participating agency, EA=environment agency, BRA=business-related agency, FA= foreign affairs agency, (-)=not defined as a lead agency, X=no participation.

As a leading agency (LA), the environment agency (EA) plays the major role in the national delegation at COPs for all selected countries except for China. The national macroeconomic agency in charge of energy and industry has the most important role for China. Business-related agencies (BRA), such as industry/energy agencies share roles with the EA in the national delegation for Japan and the ROK, but a limited role for India and the Philippines. This indicates that Japan, the ROK and China have emphasised the economic aspects of climate change. The Ministry of Foreign Affairs plays a significant role in coordinating strategies and negotiating positions in all five countries. In the case of India, delegates from diplomatic missions represent a large share of its national delegation. For the participation of other government agencies related to mitigation, adaptation, science, and finance, significant numbers can be observed for Japan, China and the Philippines.

Generally, there is no representation from local governments in the national delegation at COPs, except for India, especially at COP8, held in Delhi. No country has sent representatives from the private sector in its national delegation. Academia, however, has played an important role for China and the ROK, especially government-affiliated institutes providing scientific support, but a relatively minor role in direct representation at COPs in the cases of Japan and the Philippines. India's government-affiliated research institutes have participated consistently in the COPs.

The conference agenda often influences the size of national delegations. For example, the size of the Japanese delegation showed an increasing trend until COP7, and decreased thereafter. This may indicate that international negotiations have become less important to Japan once the binding targets and flexible mechanisms were clearly defined. The ROK and China show a continuing upward trend. This may indicate the importance of the ongoing negotiations regarding the post-2012 climate regime for both countries. The Philippines and India, on the other hand, have maintained a consistent number of delegates in COP meetings held so far.

4.2. Mandates of IACMs

Though the time of establishment and further evolution differ, IACMs in the selected countries have developed a similar structure with three layers: the EL, typically the Prime Minister's Office for overall coordination; LAs, playing major roles in domestic decision-making and implementation related to climate change; and OPAs of secondary importance.

The mandates of each IACM vary in terms of three broad functions related to (i) negotiations (e.g. preparation of national positions and strategy); (ii) climate policy making (e.g. development of national climate strategy and action plans); and (iii) domestic implementation (e.g. fulfilment of international commitments and implementation of NAPs on climate change) (table 8.13).

Table 8.13. Stated mandates of current IACMs

Mandates	Japan	The ROK	China	India	The Philippines
Negotiations-related function	-	✓	✓	-	-
Policy-making related function	✓	✓	✓	✓	✓
Implementation-related function	✓ (M)	✓ (M&A)	✓ (M&A)	✓	✓ (M&A)
Others	-	-	To integrate CC into national SD	To mainstream CC in national development	To promote public outreach

Note: (✓)=with stated mandate, (-)=without stated mandate, M=mitigation; A=adaptation, CC=climate change, SD=sustainable development.

For negotiations-related functions, although Japan has emphasised domestic implementation of the KP, the Government, through political leadership of the Prime Minister, is now engaged with its strategy regarding the post-2012 climate regime. For the ROK, negotiation has been one of the major functions of its IACM, which has a task force on negotiation. Under international pressure, the Government of China has taken negotiations seriously and negotiation-related activities were specified as a mandate of the IACM. The IACM in China usually meets twice a year, just before and after each COP, showing its concern on international negotiations. In the case of the Philippines, preparation of the country's position for UNFCCC meetings was among the mandates

explicitly provided to the former IACM, the IACCC. Under the new set-up however, while no such direct provision was provided among the IACM's mandates, the law which serves as the basis for its creation stated that its function includes collaboration with international partners at the regional, international and multilateral levels to support climate change efforts at the global level. Negotiation is clearly becoming more important to India with the recent creation of a permanent negotiating team during the March 2008 meeting of its IACM (The Indian Express 2008). However, information on how India coordinated its national strategy in the past is unclear, as the IACM was only created in 2007.

For policy-making functions, IACMs in all countries are mandated to ensure climate concerns are integrated into various sectoral activities. To fulfil these mandates, the development of a national climate strategy and action plan to provide overall guidance is typical. Japan promulgated a law to cope with global warming (1998) and developed a NAP to achieve the KP target (2005). The IACM in the ROK developed three comprehensive NAPs (1999-2007). China published its National Climate Change Programme in 2007. India and the Philippines still lack a comprehensive NAP although the Prime Minister of India announced that its NAP will be ready by June 2008. For national strategies on mitigation and adaptation, Japan has put greater emphasis on mitigation. The ROK has two task forces on mitigation and adaptation, led by the industry agency and environment agency, respectively, under its current IACM. China maintains a strong position on balancing mitigation and adaptation in the climate regime negotiations and provided specific policies and measures for both mitigation and adaptation, two key policy areas in its National Climate Change Programme. India established an IACM in June 2007 and its national strategy addressing climate change is not yet available. The Philippines included both mitigation and adaptation, *inter alia* reducing GHG emissions and designing risk reduction and adaptation response to climate change, as explicit mandates of its current IACM.

For implementation-related functions, Japan, the ROK and China developed NAPs guiding economy-wide implementation. In Japan all 47 prefectures and most municipalities developed action programmes based on the Law (1998). The private sector (Keidanren) developed a voluntary action programme (1997) with participation of key companies contributing 44% of total emissions. The ROK implemented three NAPs including 211 projects. Target plants and workplaces (1,353 as of 2006) joined a voluntary agreement programme with MOCIE and local governments to reduce CO₂ emissions or to enhance energy efficiency (KEI 2008). China's mandatory targets on energy conservation (20% reduction) and on major pollutants (10% reduction) for 2006-2010 are being implemented through disaggregation into sectoral and local targets and energy conservation agreements with 1,000 energy-intensive companies. India and the Philippines have not developed comprehensive NAPs yet and project-based or sectoral approaches have been adopted.

A promising aspect of IACMs' mandates is to integrate climate change into the national sustainable development agenda, which is explicitly stated by two large developing nations, China and India. However, an enigma is why IACMs have developed along separate lines from the apex national sustainable development councils. Japan established the Council for Sustainable Development as a multi-stakeholder forum to follow up Agenda 21 and achieve domestic sustainable development. However there is no apparent linkage between the Council and national IACM. In the ROK, the IACM is presided over by the Prime Minister while the national sustainable development council

is a standing advisory body to the President. China has not established a national sustainable development council, but has an Administrative Centre for China's Agenda 21 and the NDRC and MOST jointly coordinate other agencies in matters related to sustainable development. The creation and evolution of the national IACM in China is separate from the national institutional arrangement for sustainable development. In the Philippines, both the IACM and the national sustainable development council are under the leadership of the President, but established as two separate institutions. Separate national institutional settings for climate change and sustainable development may be attributable to the fact that this issue has not been effectively addressed in the international arena to date. Different triggers for their creation may also lead to their parallel development. Most IACMs in our case studies were established in response to the UNFCCC and its KP, while national sustainable development councils were established in response to the implementation needs of Agenda 21. How to remove this institutional barrier to re-integrate climate change into national sustainable development needs further investigation.

4.3. Evolution of national IACMs

Comparative analysis of IACM evolution was conducted by examining (i) frequency of structural change; (ii) overall coordination by the EL; (iii) LAs in IACMs; and (iv) number of agencies in the IACM (tables 8.14 and 8.15).

Table 8.14. Changes in structure and function of IACMs

Country	Frequency of change	Overall Coordination		Number of agencies
		Initial stage	Latest stage	
Japan	1	Reactive coordination	More proactive coordination	All agencies
The ROK	3	Weak coordination	Strengthened through OGPC	12
China	3	Performed by NDRC	Performed by the Premier	4 to 27
India	1	Performed by MoEF without an IACM	Prime Minister's office	Now 19
The Philippines	2	Performed by DENR	By the President's office	14 to 18

Note: OGPC=Office for Government Policy Coordination, NDRC=National Development and Reform Commission, DENR=Department of Environment and Natural Resources, MoEF=Ministry of Environment and Forests.

National IACMs have changed more frequently in China, the ROK and the Philippines than in Japan and India, possibly due to three major factors. First, some countries are more responsive to the developments in the international climate regime than others in developing their domestic institutions. For example, the initial IACMs were established in Japan (1989), the ROK (1992), China (1990) and the Philippines (1991) in response to the emergence of the climate issue in the international political agenda during the late 1980s. In addition, Japan (1997), the ROK (1998) and China (1998) made substantial structural changes in IACMs in response to the adoption of the KP in 1997. Since the Protocol laid down the respective obligations of Parties, some countries have re-arranged their institutions to be able to respond to these new commitments and/or

be able to optimise opportunities arising out of the KP. More recently, the ROK, China and the Philippines are all considering strengthening their IACMs, partly in response to mounting international pressure on developing nations to take more substantial action. In June 2007, India created an IACM in response to the fourth IPCC Assessment Report and has since then listed various priority areas, largely on adaptation. Second, institutional changes reflect different needs and approaches of domestic implementation. For example, the ROK strengthened the overall coordination by the OGPC and has recognised the role that local governments can play in the implementation of NAPs by including them in the IACM. To achieve mandatory targets, China strengthened overall coordination by the Premier and included more agencies to enforce sectoral implementation. India established an IACM to develop a NAP. The Philippines replaced the DENR (environment agency) with the DOE (energy agency) as chair in its latest IACM to emphasise mitigation. The third factor may be attributed to a change in government. In the ROK, President Kim Dae Jung strengthened institutions to deal with climate change during his presidency (1998-2002). Premier Wen Jiabao took office in 2003 and has put more emphasis on environmental issues, which has resulted in further strengthening of climate change related institutions in China. Recent changes in the Presidency in the ROK and the elevation of SEPA to ministerial level and the re-arrangement of the National Energy Agency in China may also influence their IACMs and related arrangements.

In all countries, overall coordination by the EL has been strengthened over time, due mainly to a need to deal with climate change more squarely. Japan strengthened coordination substantially when the KP was adopted. However, political leadership provided by the Prime Minister has been usually constrained because major coordination on climate change positions is controlled by two lead agencies, MOE and METI. Recently, the Prime Minister has provided political leadership to guide strategy decisions regarding the post-2012 regime. This is considered to be triggered by the fact that climate change is a major topic to be discussed at the G8 Summit 2008 to be held in Japan. Since the 3rd NAP (2005-2007), the ROK has strengthened the EL in its IACM through the OGPC, a ministerial-level body assisting the Prime Minister in policy coordination. The OGPC has fielded two delegates since COP10 (2004) reflecting this change. China has a very substantial EL headed by the Premier in its latest IACM (2007), which aims at strengthening the implementation of two mandatory targets among others. The representation from the General Office of the State Council in the national delegations at recent COP meetings indicates their growing interest in the negotiations aspect. Overall coordination had been effective even before the latest change, conducted by the NDRC, a powerful macroeconomic agency higher than ministry level. The NDRC, together with other agencies, developed a national CDM policy to impose differentiated taxes on different types of CDM projects. India, until recently, had climate change matters largely administered by the environment agency. Climate change was treated as one of several global environmental issues handled by the environment agency. Indian COP delegations are composed predominantly of MOEF and Ministry of External Affairs officials. In the Philippines, though the EL represented by the Office of the President was included in its latest IACM (2007), currently there is not enough information to show significant improvement in overall coordination. However, the formation of an Advisory Council which is chaired by an Advisor to the President (largely comprised of academicians and scientists) with the new IACM (PTFCCC) indicates an intention to strengthen the EL's presence in the IACM.

For the LAs, the environment agency, business-related agency, foreign affairs agency and science agency are key actors in national climate policy making (table 8.15). At the initial stage of an IACM, environment and science agencies played leading roles in addressing scientific aspects of climate change. At a later stage, both business and environment agencies became LAs coordinating mitigation and adaptation, respectively. This change is attributable to a changing perception from a scientific to an economic concern, as well as the resulting opportunities for both Annex I and non-Annex I parties with the adoption of the KP.

Table 8.15. LAs in national IACMs

Country	Initial stage				Latest stage			
	EA	BRA	FA	SA	EA	BRA	FA	SA
Japan	✓				✓	✓		
The ROK		✓			✓	✓	✓	
China				✓	✓	✓	✓	✓
India	✓				N/A			
The Philippines	✓			✓	✓	✓		

Note: EA=environment agency, BRA=business-related agency including energy sector and/or industry sector, etc., SA=science agency, e.g. science and technology agency and meteorological agency, etc., FA=foreign affairs agency, N/A=not available.

Japan has been represented at COPs mostly by MOE (environment agency) and METI (industry agency), together with MOFA (foreign affairs agency) (table 8.12). In the ROK, MOCIE (industry agency) played the dominant role when the KP was adopted in 1997 because the country already perceived climate change as an economic issue. MOE then started to play a more important role and now both MOE and MOCIE are two key agencies of the IACM in the ROK. The role of MOFAT (foreign affairs agency) is also important having been designated as a LA of the special task force on negotiations under its national IACM. The head of the national delegation at meetings of SBSTA/SBI is also from MOFAT. Compared with other countries, the environment agency in China is under-represented while NDRC (a macroeconomic planning agency) has played the substantial role together with MOFA and MOST (science and technology agency). This may reflect a perception that climate change is more an economic issue for China than an environment one. Another reason is that SEPA was weak in China's bureaucracy and lacked the capacity for coordinating climate change responses, an issue cutting across various sectors. However, the recent elevation of SEPA to the ministerial level and the re-arrangement of the National Energy Agency (supervised by NDRC) in the government restructure in March 2008 may imply a strengthened role for the environment agency and stronger energy policies in its national IACM. Further information is not yet available. MOFA heads the Chinese delegation at COPs and coordinates domestic positions and strategies for international negotiations. The dominant ratios of delegates from NDRC (22%) and MOFA (20%) at COPs indicates that these two agencies play the most important roles in the IACM, sharing certain responsibilities with MOST (on CDM related activities), the meteorological agency (on IPCC related activities) and the environment agency. India lacked an IACM before 2007 and the environment agency has played a major role in climate change related activities. For the Philippines, the environment agency has played a dominant role since the initial stage of the IACM (1991) until 2007 when the energy agency became the lead agency. For DNAs in the four selected non-Annex I countries, the industry agency plays the dominant role in the ROK and China while the environment agency plays the leading role in India and the Philippines.

Increased involvement of other agencies is a common feature of the latest national IACM in all five countries (table 8.14). Major agencies include (i) mitigation-related sectors, e.g. construction, transportation, electricity supply and forestry; (ii) adaptation-related sectors, e.g. agriculture, water resources and maritime affairs; and (iii) others such as finance and public affairs. Japan included all agencies and the ROK and China involved most relevant agencies, indicating their more comprehensive approaches for implementation and perception on climate change as a cross-cutting issue requiring cooperative action by all sectors. Involvement of other agencies was not apparent in India, mainly due to the absence of an IACM before 2007. In the Philippines, the number of member agencies in the latest IACM increased with the inclusion of agriculture, education, and local government agencies.

4.4. Stakeholder participation

Local governments and the private sector tend to begin to play more active roles after the country shifts its emphasis from international negotiations to domestic actions, such as implementation of CDM projects and mitigation-related activities (table 8.16). In Japan, all prefectures developed a climate change action programme as required by a national law. The ROK will include the Conference of Local Governments in its latest IACM (2008) to allow local governments to participate in the decision-making process. In China, provincial governments developed action plans and a few of them established institutions similar in structure to the national IACM to undertake activities that will help achieve national mandatory targets, which are now being implemented. Twenty-two provinces also established a CDM promotion centre. In India, several pioneer states have established CDM promotion cells.

Table 8.16. Comparison of stakeholder participation in five countries

Activities	Local governments					Private sector					Civil society					Academia				
	J	K	C	I	P	J	K	C	I	P	J	K	C	I	P	J	K	C	I	P
IACM	-	✓	-	-	-	-	-	-	✓	-	-	-	-	✓	✓	-	✓	-	✓	-
National delegation at COPs	-	-	-	✓	-	-	-	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓
Preparation of national communication	✓	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓
Promotion of CDM projects	-	-	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓	-	✓	✓	-	-
Other domestic activities*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

* Other domestic activities include domestic implementation of international binding reduction targets for Annex I countries (i.e. Japan), and other domestic voluntary actions addressing climate change by developing countries.
Note: J=Japan, K=The Republic of Korea, C=People's Republic of China, I=India, P=The Philippines, (✓)=involved, (-)=not involved.

In Japan, a voluntary action programme has been adopted by the Keidanren to help achieve national GHG reduction targets. In the ROK, voluntary agreements have been concluded between individual plants and the Government to implement NAPs. In China, national targets are disaggregated into sectoral targets and have been enforced

by signing target responsibility agreements between the NDRC and major enterprises. India has representatives from the private sector in its newly established IACM (2007). In developing countries, particular in India and China, the private sector is very active in developing CDM projects supported by their governments. As of February 2008, India and China hold 33.4% (ranked 1st) and 16.7% (ranked 2nd), respectively, of total projects registered by the CDM-EB. In all countries, with a mix of policy measures in place, such as laws and regulations, economic incentives, financial mechanisms and information disclosure instrument, the private sector is gradually changing production behaviour toward energy and carbon decoupling.

Based on the country's representation at COPs and its involvement in national IACMs, civil society seems to have played a more active role in India and the Philippines than in other countries. Reflecting differences in how governments view civil society, Japan seems to be concerned about the legitimacy of civil society as formal representatives at COPs and in the national IACM, while India and the Philippines have domestic legislation to empower the participation of civil society. In general independent civil society plays a limited role in China compared with other four countries. However, civil society groups working in the environment are more active than in other areas. The ROK is located in between by including representatives from the PCSD, a multi-stakeholder mechanism on sustainable development, in its national delegations. When a country moves to the grassroots implementation stage addressing mitigation and adaptation, civil society can be expected to participate more actively in raising public awareness, educating people to change their behaviour, supporting research and surveys, disseminating information and monitoring the progress towards achieving national targets on climate change.

Academia has played an active role in most domestic activities related to climate change. Government-affiliated or independent institutes have supported R&D, international negotiations, national GHG inventories, scientific information and data, and climate policy making. In the ROK, the inclusion of academics as an expert pool in the IACM from the outset is a distinctive characteristic. In China, government-affiliated research institutes and national universities are included in domestic CDM approval processes. Academics in the ROK (18%) and China (22%) have a high proportion of national representation at COPs, most of whom are from government-affiliated institutes. In India, scientists and experts participate in the IACM in their personal capacity and Indian research institute have been very active members in the conduct of significant region-wide and international climate research activities. In all countries, research institutes provided technical support to develop a GHG inventory for their national communication. Japan, China and India have made significant contributions to IPCC related work. Japan and China had 154 and 43 contributors respectively to the IPCC 4th Assessment Report. Japan, the ROK, China and India have built relatively strong capacity in climate related science and technology, but the Philippines still needs to improve its scientific and research capacity.

5. Conclusions and recommendations

Based on the comparative study across five countries, several tentative conclusions and policy recommendations regarding national institutional development response to climate change in Asia have emerged.

First, there is no “ideal” institutional arrangement that can work well for all countries. Nevertheless, the IACM as a national institutional response to address climate change is clearly more appropriate than fragmentation to combat climate change, a complex issue that cuts across almost all sectors. In response to climate change-related matters at both international and domestic levels, the IACM may prove to be an effective institutional arrangement in coordinating various roles and contributions of involved government agencies to deliver, among others, (i) a consistent national strategy and position for international negotiations; (ii) a coherent and coordinated domestic action plan guiding the fulfilment of international commitments and respective national goals related to climate change; and (iii) effective nation-wide implementation. An IACM may also act as a mechanism to further promote and ensure wider participation of other stakeholders in policy-making processes and implementing climate change-related policies and programmes.

To provide a consistent domestic strategy and position for international negotiations, especially on the post-2012 climate regime under the UNFCCC, an IACM should function to coordinate the perceptions of various agencies and the EL should provide overall coordination and leadership. Once in place, the IACM may create more channels to engage the participation of various interest groups. For example, when implementing mitigation measures, the government would be seen less as a regulator and more as a development partner if it included from the beginning the private sector in the preparation of domestic strategy and determining the position for international negotiations. In this regard, Japan and India provide some good experience by involving representatives from the private sector in their national IACMs. Since a country's position in international negotiations largely hinges on associated domestic costs and benefits related to international commitments, the IACM will benefit more by working closely with other stakeholders, which can either contribute to reducing these associated costs or optimising the benefits from a given measure. Special committees or forums under the IACM could be optional channels to reflect the voices of various interest groups and integrated assessment could be used as a tool to assist decision-making. In our case studies, the ROK will establish a conference of local governments in its latest IACM (2008). India and the Philippines have representation of civil society at COPs and in their national IACM. In addition, scientific assessment and policy research should be undertaken and applicable for supporting national decision-making and policy-making. Effective participation from academia may be sought by developing, among others, national guidelines for science and technology research related to climate change, providing increased funding for R&D and strengthening networking mechanisms at both domestic and international levels for their continuous contributions to negotiation-related activities. The ROK, China and India, among others, provide some good experience in this respect.

Each IACM should prepare a NAP on climate change, serving as a basic guide for economy-wide implementation of mitigation and adaptation measures. In this regard, a NAP will help each country fulfil its international commitments and their respective national goals related to climate change. Most selected developing countries are trying to make adaptation an integral part of their national strategy addressing climate change. The ROK established task forces on mitigation and adaptation under its latest IACM (2008). China provided explicit policies and measures on both mitigation and adaptation, which are two strands of national policy addressing climate change. India established an IACM in 2007 and since then set various priority areas largely on adaptation. All selected countries include adaptation-related agencies, such as

meteorology, agriculture, forestry, water resources, and maritime affairs, among others, in their national IACM. For mitigation, quantitative national targets should be defined with concrete measures to ensure their achievement. Each country is faced with unique economic, political and social conditions and differing circumstances in responding to climate change, such as resource endowments, energy supply and mix, national GHG inventory, best available technologies, business competitiveness and co-benefits of mitigation as outlined in Chapter two. These differences also influence each country's policy priorities to address the many challenges related to climate change. Japan, the ROK and China, among others in Asia, provide some good experience in this respect.

To ensure effective nation-wide implementation, an IACM should provide horizontal coordination of measures undertaken by different ministries and vertical coordination of local government efforts at various levels. For mitigation, sectoral action plans and local action plans with quantitative targets may be a pragmatic option. Clear linkages between sectoral implementation, local implementation and national targets should be identified by the IACM. To ensure effective implementation of national targets, the overall coordination of the EL in the IACM is important. In the implementation stage, other stakeholders should be brought into full play.

Local governments, as the level of governance closest to human activity, can play a crucial role in educating, mobilising and responding to the public to make grassroots changes in human behaviour. They also help implement national targets by initiating local action plans and projects and oversee their implementation. For local governments, Japan, the ROK and China have developed local action plans. In the ROK's latest IACM, the Conference of Local Governments will be established to provide a channel for their participation. For effective promotion of CDM projects, local promotion bodies established in China and India could be emulated.

The private sector, as a major contributor to both social prosperity and many environmental issues, should live up to their social responsibilities and change their behaviour by adopting energy and resource decoupling production systems (see more in Chapter nine). In our case studies, the voluntary agreement approach for mitigation adopted by enterprises in Japan and the ROK provides a good model. In China, a levy system has been set up to stimulate the private sector to develop CDM projects for priority areas defined by the IACM.

Civil society has played a vital role in the promotion of participatory democracy, especially since the Rio Summit. NGOs can act as a lobby or pressure group to influence the national political agenda on climate change, initiate campaigns to raise the public consciousness on climate change and educate people towards responsible and climate-friendly consumption, aid vulnerable groups who are victims of natural disasters due to extreme climate events, dissemination and disclosure of information on national policy and business behaviour, and assist in monitoring policy implementation, among others. From the country cases, India and the Philippines provide useful experience such as NGO representation in national IACMs and in national delegations at COPs.

Academia can provide the scientific data and information and science and technology know-how that policymakers need in domestic policymaking. The ROK and China have established specific coordination mechanisms between the IACM and academia, especially government-affiliated institutes. These include the participation of

government-affiliated institutes in national delegations at COPs, as an expert consulting body to the IACM, and allocation of budget for R&D on climate change, among others.

Second, countries considering an IACM as a national institutional arrangement to address climate change can consider the hierarchical model, tiered into EL, LAs and OPAs with their distinct mandates and modes of cooperation, as a practical option. To ensure efficient and effective overall coordination, the Prime Minister/President (or representatives on their behalf) should provide strong leadership to coordinate competing or conflicting interests among ministries related to climate change and coordinate local governments and other stakeholders. To integrate mitigation and adaptation in the national action plan on climate change and to ensure its implementation, the industry/energy agency (for mitigation) and the environment agency (for adaptation) should be empowered as LAs among other ministries according to domestic circumstances, *inter alia* bureaucratic arrangements and policy priorities addressing climate change. Sectors other than industry/energy contributing substantially to national GHG emissions (e.g. agriculture, transportation and construction, etc.) or related to adaptation (e.g. meteorology, agriculture, forestry, water resources, maritime affairs, public health and public affairs, etc.) should be included as OPAs.

Third, although most IACMs were established as an institutional mechanism in response to climate change at both international and domestic levels, it is timely for all countries to shift their national emphasis from international negotiations to domestic actions addressing mitigation and adaptation. It is also important for all countries to move forward from climate change as a stand alone national agenda to being part of the ongoing national sustainable development effort. How to make this change should be further studied. At the implementation stage under the UNFCCC, an effective institutional arrangement should feature (i) strong overall coordination by the EL; (ii) empowerment of the industry/energy and environment agencies as joint LAs coordinating mitigation and adaptation; (iii) involvement of all major sectoral agencies related to mitigation and adaptation; and (iv) maximisation of the use of the comparative advantages of other stakeholders as mentioned above.

Fourth, the four factors listed above for improving domestic institutional capacity related to climate change need to be tailored to domestic circumstances. For the selected countries, due to different domestic circumstances and international commitments, Japan, the ROK and China possibly have more advanced institutional capacity than India and the Philippines. If each country needs to make more substantial efforts to address climate change in the future, there seems to be room for the improvement in domestic institutional arrangements (table 8.17).

Table 8.17. Status of current domestic institutional arrangements

Success factors	Japan	The ROK	China	India	The Philippines
Law on climate change	✓	X	X	X	X
NAP addressing both mitigation and adaptation	✓ (M)	✓ (M&A)	✓ (M&A)	X	X
Overall coordination by the EL	Medium	Stronger	Stronger	Weaker	Weaker
BRA and EA as joint leading agencies coordinating mitigation and adaptation	✓	✓	✓	✓	✓
Involvement of relevant sector agencies as OPAs	✓	✓	✓	✓	✓
Well established mechanisms to empower stakeholder participation	LG, PS, AC	LG, PS, AC	LG, PS, AC	PS, CS, AC	LG, PS, CS
Integrate climate change into national sustainable development	X	X	X	X	X

Note: NAP=national action plan, EL=executive leadership, BRA=business-related agency, EA=environment agency, OPA=other participating agencies, LG=local governments, PS=private sector, CS=civil society, AC=academia, (✓)=present, (x)=absent.

This comparative study indicates, for example, that the following measures can be considered to improve the performance of national IACMs in five countries:

- (i) The overall coordination of the EL could be strengthened for Japan to ensure effective implementation and the integration of mitigation and adaptation in Japan's national action plan and local action programmes needs to be addressed.
- (ii) Empowerment of the environment agency to play a more important role in the national IACM and strengthening the implementation of national action plan could be considered for China.
- (iii) More effective mechanisms to mobilise participation of civil society could be established in Japan, the ROK and China.
- (iv) NAPs could be considered for India and the Philippines to provide overall guidance to domestic implementation.
- (v) Capacity for scientific research could be increased for the Philippines.
- (vi) Integration of climate change into national sustainable development planning and implementation could be promoted for all countries.

Future research agenda - In this study, an analytical framework was used to examine national institutional arrangements addressing climate change for a comparative study of five Asian countries. In the future, a study on institutional development on climate change in Asia may be extended to include other countries, especially those with peculiar national conditions, such as small island developing states, least developed countries and oil exporting countries. Future research may also delve into more in-depth study of the five countries originally chosen; for example, the effectiveness of each IACM and policies related to climate change at the national, sectoral and local levels.

The enigma of why climate change has been treated as a stand alone development issue rather than being integrated into existing national sustainable development

structures, measures and implementation plans requires further research. Separate climate change action plans that conflict with national sustainable development plans are clearly undesirable but possible if institutional arrangements remain apart.

The final goal of effective institutions is to achieve grassroots behavioural change. Unless the relations between specific institutional arrangements and associated behavioural changes are understood, the effectiveness of institutions can not be assessed. Although some success factors for establishing an ideal institutional arrangement were identified, this does not help to assess the effectiveness of real world institutional arrangements in achieving tangible climate change outcomes. This remains a challenge for future research.

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Endnotes – Chapter 8

¹ The ROK's case study was based on secondary information provided by the Climate Change Research Division of the Korea Environment Institute according to a structured questionnaire.

| CHAPTER 9 |

RESPONSIBLE BUSINESS –
ENERGY EFFICIENCY SOLUTIONS



Chapter 9

Responsible Business – Energy Efficiency Solutions

1. Introduction

As the debate on global warming gains prominence in international policy regimes, there is a growing consensus that concerted action by the business sector to deal with climate change is both necessary and urgent. In most parts of Asia, business investment and industrial development is the major driver for economic growth and employment generation. But this economic development is interlinked with emissions and energy use. As highlighted in Chapter two, Asia currently consumes around 2,655 Million tonnes of oil equivalent (Mtoe) of energy per year accounting for 27% of the world's total supply. Industrial energy use is the source of about 80% of greenhouse gas (GHG) emissions in Asia, and its share of worldwide emissions increased from 8.7% in 1973 to 24.4% in 2005 (ADB 2006). This is expected to increase to 40% by 2030 if the current rate of industrial growth and energy consumption continues (WEC, 2001). For emissions to be reduced in a drastic way, industry will have to rely on non-fossil fuels for energy supplies. Today, Asian industries depend on fossil fuels for more than 70% of primary energy needs, so the adjustment needed is massive. Coal remains the major source of energy for China and India, at 70% and 37%, respectively. To cut emissions, industries can either drastically reduce fossil fuel use or strictly limit industrial energy demands through conservation. The challenge is that basic manufacturing industries will certainly continue to grow in Asia. The first option is not feasible at least in the short run; demand for energy continues to increase and there are doubts as to whether Asia can develop renewable energy sources fast enough to phase out coal-based plants (renewable energy currently account for less than 5% of the total supply). However, tapping the potential for energy efficiency (EE) gains holds considerable promise for Asian industries, as this can reduce electricity demand for fossil fuel, arrest climate change and yield business benefits.

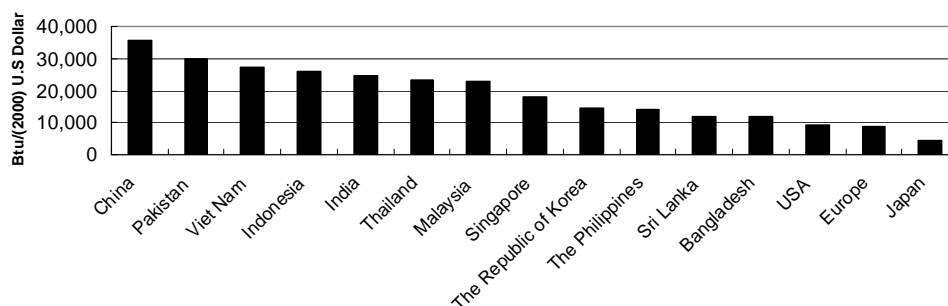
Demand side EE is a good example of a “no-regrets” strategy for any business, irrespective of type and size. Improving EE simply implies using less energy to achieve the same amount of production and services. This chapter argues that a vigorous EE strategy could enable greater emission reductions than any other climate change alternative (and boost business performance). The key focus is on improving EE in manufacturing industries. EE measures typically have short pay-back periods and ultimately add to bottom line profits as energy prices increase. As the following section explores, the potential for EE programmes and policies in Asia remains immense, although there are several barriers for implementing specific measures. Accelerating EE measures will not only benefit business but will also increase energy security and step up the transition to a less carbon intensive economy. There is no apparent conflict between EE and sustainable development; a tension that permeates most other chapters of this White Paper. Through corrective policy measures and actions by

business and intermediaries for promoting EE, it is possible to achieve a meaningful and effective near term goal of reducing GHG emissions, creating momentum towards the deeper cuts that will be necessary in the long run.

2. Decoupling energy use and industrial growth

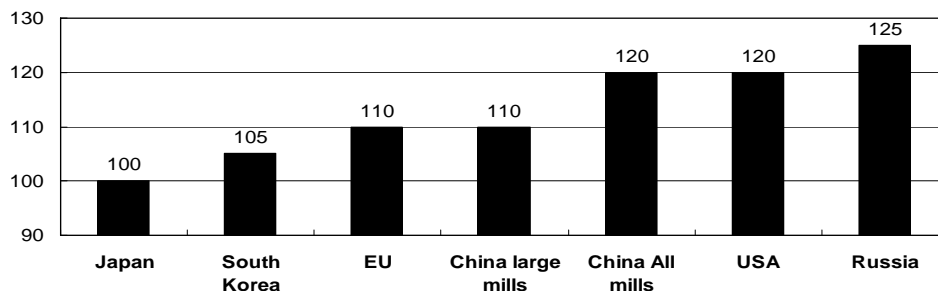
Aware of the necessity to continuously decouple energy use, GHG emissions and economic growth, Asian countries have devised various policy measures to guide industries. As a result, some countries like Japan made exemplary advances in EE, while other developing countries are inching towards better energy performance (fig. 9.1). By comprehensively adopting EE measures, Japan has been successful in decoupling its economic growth and industrial energy use, so that growth in industrial output has been offset by a decrease in energy intensity; a combination of increasing efficiency, fuel and process changes and a shift to more energy efficient electrical appliances lie behind it. Japanese efficiency improvement programmes also produced long lasting improvements to industrial production processes, new product designs and business models that save energy without reducing levels of service (Medlock and Soligo 2000; Murokoshi 2005; Sugiyama and Ohsita 2006).

Figure 9.1. Energy consumption per GDP in selected countries (2005)



Source: BP (2007)

The factors behind varying levels of energy intensity include industrial structure, production processes, and domestic energy sources. Countries like China witnessed an industrial restructuring process in the 1990s, when the industrial portfolio was diversified to include light industries such as telecommunications and thus reducing energy intensity. However, Asia's industrial activity remains dominated by the manufacturing sector, which accounts for 36-42% of total energy consumption in many countries. Heavy industries like chemical and petrochemicals, iron and steel, cement, paper and pulp account for more than 70% of energy consumption in large industrial economies like China and India (IEA 2007). For example, the iron and steel industry consumes about 19% of total energy use and produces about 25% of the direct carbon dioxide (CO₂) emissions in India. However, a lot of energy is used ineffectively in Asia, either because of inefficient industrial production processes and obsolete technologies, or because of the low quality of raw materials. This partly explains why the average EE of iron and steel industries in China and India is lower than in Japan (fig. 9.2).

Figure 9.2. Comparative rates of energy use in integrated steel mills

Note: index based on 100 for Japan
Source: Yamada (2007)

As explained in Chapter two, improving EE is the most cost-effective mitigation option available at the national level. At the sectoral level, ample opportunities exist in the heavy industry sectors for improving EE by adopting the world's best technologies and production processes (table 9.1). These sectors can improve their EE significantly, by 18-26%, while reducing CO₂ emissions by 19-32%, simply by identifying options for improvement and applying proven EE measures. By reducing energy use per unit of output or service delivered, industrial enterprises could save money, reduce maintenance costs, increase productivity, and improve product quality.

Table 9.1. Energy efficiency improvement potential in key industrial sectors

Sectoral category	Energy efficiency improvement potential	
	Mtoe/year	MtCO ₂ /year
Chemicals/petrochemicals	120-155	370-470
Iron and steel	55-108	220-360
Cement	60-72	480-520
Pulp and paper	31-36	52-105
Aluminium	7-10	20-30

Source: IEA (2007)

Table 9.2 illustrates EE initiatives by selected world-class companies in key industries that provide compelling business cases of how to make a profit while saving 20–40% of energy use, with pay-back periods of less than one to five years.

EE improvement brings other socio-economic benefits too. Cost-effective energy savings at the factory level means lower dependence on fossil fuel imports and trade deficits, in the face of high and rising oil prices. For example, in 2004 net oil imports into China exceeded 100 million t/yr and accounted for about 45% of total oil consumption (Xu 2007). By 2010 the ratio of oil imports is predicted to approach 50%. Hence, improving EE means improved energy security for fast moving economies like China. Even without higher oil prices, there are sound business reasons to promote energy efficiency. Achieving EE requires services and technology, thus creating new business opportunities and jobs. Estimates for Germany indicate that more than 2,000

entrepreneurial jobs could be created for every 1 Mtoe saved as a result of investments in EE. Moreover, increased EE contributes to improved air quality by avoiding combustion of fossil fuels (Mohanty et al. 1997). Overall, EE is a significant contributor to sustainable development.

Since there are significant benefits and ample potential in almost all key sectors for improved EE, why is not there enough momentum to embrace it in Asia? Significant barriers remain for widespread adoption of EE measures that need to be identified and understood, if they are to be addressed.

Table 9.2. Benefits of energy efficiency improvement

Country and sector	Business approach to EE	Environmental benefits	Investment	Economic Benefits	
				Cost savings/yr	Payback period
Bangladesh <i>Pulp & Paper</i>	Production process improvement	Emission reduction: 100 tCO ₂ e/yr Fuel oil savings: 37.5 kl/yr	\$3,448	\$5,172	8 months
China <i>Chemical</i>	New technology/equipment	Emission reduction: 51,137 tCO ₂ e /yr Coal reduction: 33,643 t/yr	\$624,000	\$1,225,033	6 months
India <i>Pulp & Paper</i>	Production process/Equipment change	Emission reduction: 17,200 tCO ₂ e /yr. Coal savings: 11,520 t/yr	\$46,512	\$400,186	2 months
<i>Iron & Steel</i>	Process optimisation and good housekeeping	Emission reduction: 6,787 tCO ₂ e/yr Electricity savings: 7.6million kWh/y	none	\$353,488	Immediate
Indonesia <i>Cement</i>	Production process/equipment modification	Emission reduction: 24,349 tCO ₂ e/yr Electricity savings: 3 MVA	\$170,000	\$1,124,130	1.5 months
Philippines <i>Iron & Steel</i>	Good housekeeping	GHG emission reduction: 2,035 tCO ₂ e/yr Fuel savings: 678,487 l/yr	\$2,545	\$148,028	One week
Sri Lanka <i>Ceramics</i>	On-site recovery/reuse	GHG emission reduction: 126 tCO ₂ e/yr Kerosene savings: 49,000 l/yr	\$60,000	\$12,250	5 years
<i>Iron & Steel</i>	Improved process management and new technology	GHG emission reduction: 416 tCO ₂ e /yr Fuel oil savings: 150,000 l/yr	none	\$30,000	Immediate
Thailand <i>Chemicals</i>	On-site reuse and recovery	Emission reduction: 15 tCO ₂ e/yr Electricity savings: 24,545 kWh /yr	\$5,250	\$5,406	One year
Vietnam <i>Ceramics</i>	Input material substitution and good housekeeping	Emissions reduction: 468 tCO ₂ e/yr Electricity savings: 130,200 kWh/yr	Negligible	\$40,202	Negligible

Source: UNEP (2002b); UNESCAP (2003); WEC (2007); tCO₂e/yr = tonnes of carbon dioxide equivalent per year.

3. Barriers to energy efficiency improvement

Many studies (ADB 2006; IEA 2007) indicate significant potential for EE improvement in Asia, in the order of 25-30% per sector, of which only a fraction has been achieved to date. The energy intensity of Asia remains 1.5 to 4 times greater than G8 countries. Fast growing economies like China, even with strong energy conservation action plans, are struggling to attain their medium term targets. The EE investment opportunities available for businesses have remained largely undeveloped due to various policy, management, technology and financial barriers. These barriers can be analysed by grouping them into three categories—government intervention, public sector capacity and the support system—and will be analysed below.

3.1. Barriers related to government intervention

To reduce the waste of energy in industrial operations, appropriate government strategies, regulations and incentive mechanisms are needed. Many policy interventions in Asia are not well targeted, and perverse subsidies affect industrial decisions on investment in EE.

3.1.1. Lack of sectoral targets, standards and incentives

Unclear targets and poor planning by national governments could reduce the credibility of industries to invest in EE improvement. Formulating industrial development policies for short-term economic gains often ignores the importance of tapping EE potential and long-term sustainable development goals (UNEP 2006a). Integrating energy conservation policies with other resource policies and fixing progressive targets for high impact sectors, as well as designing standards for clean production processes and equipment, were found to underpin higher EE in the Organisation for Economic Cooperation and Development (OECD) countries (APO 2001). In Asia, the lack of standards and targets inhibits EE investments indirectly by leading industry to undervalue EE's contribution to company performance. In industrialised countries like Japan, greater energy savings are gained by developing energy standards for specific kinds of industrial equipment such as boilers, electric arc furnaces, low thermal refractory and rotary kilns. When those standards are combined with sectoral targets and financial incentives, EE is improved (box 9.1).

Taking up energy intensive industries like iron and steel, chemicals, pulp and paper is inevitable for Asia, necessitating large energy inputs, often supplied by coal-fired power plants. Developing countries in Asia have made little effort to set targets for energy savings in high impact sectors and new coal-fired power plants find no compulsion to adopt the best available world standards. Even if standards exist in countries like China, the design and implementation of such industrial codes requires information and procedural instructions that are often missing. Furthermore, in many cases, enforcement is less vigorous and incentive mechanisms, such as tax breaks or low-interest credit, are not well coordinated among the authorities. Hence, industries disregard the need to change obsolete production practices or to innovate with more efficient practices.

Box 9.1. How Japan achieved greater energy efficiency

The 1970s oil embargoes led Japan to focus on EE, resulting in a progressive energy conservation law, first enacted in 1979. That law stipulates (i) to identify energy intensive sectors; (ii) to appoint licensed energy managers for energy intensive industries; and (iii) to buy and use products that meet mandatory EE standards. In 1999, Japan adopted the Top Runner Programme to push manufacturers to meet EE standards by identifying the production process with the highest EE in the market at the time of standards setting and evaluating the potential for further EE improvements. This ensures that target values are set at a high level. Special labelling systems are also established so that users can readily obtain information about EE at the time of purchase. Quantitative estimates of the significance of this programme vary, but expected reductions in GHG emissions fall within the range of 16-25% of the entire national savings target by 2010, or about 29 million tCO₂e/yr. Progressively amended six times, the law includes a variety of fiscal incentives such as tax exemptions, special depreciation allowances and soft loans to promote energy conservation measures by designated industry sectors. A reduction of 1% per year in energy consumption levels by all designated factories was the main goal of the new law. The law also introduced special tax measures such as a rebate equal to 7% of the purchase price of EE equipment and loan support for energy efficient investments by industry. The Government offered a low-interest rate of 2.2% to industry for up to half the cost for a period of 1-30 years. Because of these and other measures, since the law was enacted in 1979, emissions from industries have been reduced from 524.23 million tCO₂e/yr in 1997 to 498.51 million tCO₂e/yr in 2003, despite the fact that Japan's industry continued to grow. Today Japan is a leading country in EE and has developed an industrial system that continuously improves EE. It is also important to note that the industrial structure of Japan changed over the last three decades, as polluting industries shifted overseas for economic reasons.

3.1.2. Presence of perverse subsidies

Under-pricing of energy through government subsidies is a policy impediment that undermines the cost-effectiveness of energy investments made by industry. In Asia, energy prices are under government control, and many countries subsidise it at the producer or consumer level somewhere between 10-30%. Even though governments have compelling socio-political reasons for providing such perverse subsidies to fossil fuel users, they often do not reflect the full environmental costs and nullify manufacturers' interest in EE improvements (Xia 2003). As a rule, countries that subsidise energy prices under-invest in EE. Subsidies to state-owned electricity utility companies as well as to public sector industries are another price distortion, causing industry to adopt inefficient technologies. Such subsidies have direct implications for primary energy use and increase dependence on imported fuel. In some countries like Indonesia, the average rate of subsidies is as high as 28% (table 9.3). Removal of such subsidies could reduce energy consumption by 7.1% with a net CO₂ reduction potential of 11%. The United Nations Environment Programme (UNEP) (2002a) projected that on average, the removal of consumption subsidies that have no environmental value can reduce energy use by 13% in the region, lower emissions by 16% and increase GDP by almost 1%.

Table 9.3. Impact of removing subsidies on energy consumption in selected countries

Country	Average price of gasoline* (\$/L)	Average rate of subsidy (% of market price)	Annual economic gain (% of GDP)	Reduction in energy consumption (%)	Reduction in CO ₂ emissions (%)
China	0.58	10.9	0.4	9.4	13.4
India	1.22	14.2	0.3	7.2	14.1
Indonesia	0.48	27.5	0.2	7.1	11.0
Iran	0.11	80.4	2.2	47.5	49.4
Kazakhstan	0.79	18.2	1.0	19.2	22.8
Russia	0.77	32.5	1.5	18.0	17.1

Note: prices as of December, 2007

Source: UNEP (2002a)

On the other hand, subsidies for introduction of energy efficient technologies and to support renewable energy (RE) resources can help to reduce emissions (De Araujo et al. 1995; Marcillo and Menke 2006). Most industrialised countries have been increasing these positive subsidies for energy security reasons.

3.2. Barriers related to private sector aspects

Investment in EE is eventually a business decision and corporate commitment is an important factor. Every company, irrespective of size, wants to obtain maximum profits at the least cost of investment. Business attitudes towards risk, managerial capacity, and poor corporate social responsibility (CSR) are some of the barriers that must be overcome.

3.2.1. Risk aversion characteristics

EE as a path to profit making is not viewed as an integral component of the corporate decision making process. In Asia, any alteration to achieve a positive change is often perceived by the business sector as disruptive to the present order (Kumar et al. 2005). This is common for both company management and employees. Corporate managers often consider the latest technologies as the only way to significantly improve resource efficiency, even when reductions are also possible by improving existing production processes, recycling of materials, better bookkeeping and introducing innovative management systems (box 9.2).

While technically competent managers are being developed at the company level across Asian economies to manage industrial growth, their capacity to appreciate global and national EE issues continues to be low. In one survey of energy utility and mining companies, limited awareness and lack of best practices were found to be a major hurdle in corporate efforts to enter into new energy-saving approaches (PricewaterhouseCoopers 2007). Even if awareness exists, factory managers consider opportunity costs before they make investments in EE (Morgenstern et al 2007). Thus, only EE investments that have proven short pay-back periods with little investment cost get final clearance from the top management.

Box 9.2. A business case of improving energy efficiency in China

The Qingdao Port Company in Shandong Province saved 3.62 million kWh of energy in a five year period. Even though operational capacity increased 15.8% per year, energy consumption was reduced by 8.9% per year over the same period. The saved energy is equivalent to 686 tonnes of oil and 578 tonnes of coal. The company achieved its energy savings by (i) establishing multiple levels of EE targets and an energy management framework; (ii) training workers on energy-saving methods; (iii) creating an incentive system for innovative ideas; and (iv) modernising equipment and machinery. The good performance on energy conservation and economic performance enabled the company to be recognised as a National Environmentally Friendly Enterprise in 2005.

Source: Qingdao Daily (2005)

This risk aversion barrier and business rationality displays a different dimension in public sector companies. For example, in China and India, heavy industrial sectors like steel and chemicals are still dominated by large state-owned organisations. Corporate management in these firms is less responsive to calls for improved EE as they can ignore market forces through tools like monopoly pricing or their ability to absorb losses.

3.2.2. Missing capacity of small and medium enterprises

In small-scale industries that dominate Asia's industrial sectors (about 70-80%), risk aversion is aggravated by a lack of resources (OECD 2005; CREM 2004). Despite their significant contribution to economic development in their capacity as suppliers to large industries, small and medium enterprises (SME) are energy inefficient since they continue to operate with obsolete technologies and production processes. On average, electricity accounts for 10% of production costs for SMEs in developing countries like Vietnam, but because of a lack of funds and skills, and with management accountability tied to short-term profits, managers defer attention away from energy saving. Small-scale operations also make investments on EE uneconomic on an individual basis by those industries (UNIDO 1997).

Furthermore, most SMEs are not registered, remaining part of the informal economy and therefore disconnected from government-sponsored capacity building programmes and venture capital provided by private financial institutions. From the lenders' point of view, assessing the creditworthiness of these industries is difficult, as they often have no reliable financial records and have difficulties meeting collateral requirements (Mohanty and Visvanathan 1997). Even if SMEs can establish their creditworthiness, they need to follow tedious procedures to gain access to low-interest loans earmarked for improvements in EE. Many are turned off by the procedural delays and do not want to obtain commercial loans, even if offered at low-interest rates (CREM 2004).

3.3. Barriers related to supporting systems

Improving EE depends on access to technology, availability of financial capacity and capable human resources. The competence of Asian business in this aspect is constrained by numerous forces.

3.3.1. Access to energy efficient technologies

OECD countries like Japan have a huge lead in technology and process development in almost all key sectors. The access to energy efficient technologies constitutes an important barrier to adoption by Asian industries. Generally, Asia has not kept up with technical innovations for energy savings, although China, India and the Republic of Korea have been successful in developing prototype technologies for light industries like food processing and textiles. Upgrading obsolete technologies in heavy industries like steel, cement, and paper is often found to be expensive, as new technologies need to be transferred from advanced economies. Box 9.3. illustrates how the high cost associated with importing technologies is a barrier to promoting EE in Sri Lankan steel mills.

Box 9.3. Cost of importing energy efficiency technologies in Sri Lanka

Raw steel is usually imported to Sri Lanka to meet rising demands. The cost of finished steel production is nearly four times that of raw materials, but the effect of value addition is very critical to the economy due to the limited supply of finished products. Sri Lankan steel mills opted to maximize profit by increasing total production, rather than by investing in EE measures because of (i) necessity to import all equipment and technologies for making improvements; (ii) high interest rates for investment capital; and (iii) the time required to implement EE measures.

Source: UNEP (2002b)

Technology transfers are often seen as a business-to-business interaction, but institutional barriers and policies influence the transactions. Lack of coordination and direction for technology/knowledge sharing constrains Asian businesses from adopting promising energy efficient processes already available elsewhere (Reddy 2001). The barriers include restrictive policies, such as intellectual property rights (IPR), which are imposed to ensure recovery of original technology development costs. Limited markets for technologies are also another important barrier. As specialized applications, new technologies often need to be customized for each factory, in either scale or operational features. This makes it difficult for technology suppliers to design uniform products to reap the benefits of small markets. Technology transfers that come as part of foreign direct investment (FDI) are often provided at less than favourable terms. Some studies show that government supported technology transfer programmes are often incompatible, and dumping outmoded production technologies is common (Tharakan et al. 2001; Yoshi and Yokobori 1997). Many companies purchase outmoded production equipment (or whole factories) from developed countries after the equipment has been depreciated and written off the seller's accounts.

Furthermore, the transferred technologies may fail to suit local conditions (Thiruselvam et al. 2003). Technological and information incompetence in Asian industries also account for (i) high initial transaction costs in searching for and accessing information (APO 2005); (ii) limited availability of funds to upgrade technologies (Klessmann et al. 2007); and (iii) the inability of the workforce to acquire new skills (CREM 2004).

3.3.2. Availability of finance

Some technology options provide huge energy savings and a short pay-back period, but require a high initial investment, which is not easily available to many Asian companies. These companies simply do not have ready access to money or their banks do not have confidence to back them in undertaking new risks. Most private financial institutions operate on a risk minimisation approach and need collateral backing for loans. Under these circumstances, EE projects do not always produce acceptable appraisal results (UNIDO 1997). Capital rationing by financial institutions for more promising investment alternatives and the lack of technical capability in the banking sector to appreciate broader EE benefits are also barriers.

Venture capital for financing energy investments for small business is a new concept with very few institutions providing such financing. Emerging financial mechanisms such as energy service companies (ESCO), which provide the investment capital for a share of the financial savings, face many obstacles in trying to help companies willing to invest in EE (box 9.4).

Box 9.4. Barriers to the growth of energy service companies in Japan

To be successful, ESCOs need long-term contracts with their clients to cover the initial investment. Until recently, expenditure plans and contracts of government organisations were limited to five years in Japan, forming a critical barrier to adopt ESCO assistance. To remove this obstacle, a recent law allows government organisations to extend the contract period for up to ten years. Accelerating the growth of ESCOs among small business and households also needs new policy approaches. IGES (2007) is currently working on a household ESCO scheme that would attempt to solve the lack of profitability of ESCOs using collaboration and burden sharing by stakeholders. In this scheme, the local bank would serve as the financial service supplier, retail shops would provide electric appliances, environmental specialists serve as energy service advisers to households, and a local public body is the service coordinator. In another study on product service systems which analysed the sustainability potential of ESCOs and their business performance, IGES (2007) suggested an inter-ministry, multi-stakeholder working group to evaluate appropriate financial incentive mechanisms.

International finance options such as the clean development mechanism (CDM) have created unrealistic expectations among SMEs, which are unaware of its expensive processes and complicated criteria (Kumar et al. 2005). Businesses in industrialized countries, which are ready to help Asian business partners, are often hampered by the lack of information on the energy-saving potential available in the recipient companies. Moreover, in some transitional economies like Vietnam and Mongolia, access to foreign currency is controlled and, when foreign financing is available, investors are asked to bear the foreign exchange risks during the loan repayment period.

3.3.3. Capable human resources

Lack of technical education and training of employees is another barrier. The benefits of EE in environmental and economic terms are sometimes beyond the common sense

of managers as well as employees but their involvement is important for proper implementation at the factory level. Poor understanding of the functional characteristics of EE measures will increase the costs, hamper the achievements of desired results and even disrupt the production process if not implemented correctly. In one survey of employees, a large-scale chemical manufacturer in India discovered that illiteracy was a major hurdle in improving energy performance (Jose 2005). In small and medium-sized factories, incompetence in tackling EE measures also stems from management decisions to lay off skilled employees to increase profit margins. Energy support services from non-core activities for small industrial units and when skilled technical staff are replaced by less capable employees, efforts to seek and improve EE are set back.

4. Asian initiatives towards improved energy efficiency

Despite these barriers, in the last two decades Asian governments and business have both shown an interest in EE as the quickest and most cost-effective way to address the environmental and economic challenges of climate change. Actions undertaken can broadly be grouped into governmental plans, private sector voluntary initiatives, and actions undertaken by intermediaries in promoting specific EE programmes across the region.

4.1. Action at the government level

Key policy actions taken by the Asian governments aimed at improved EE include energy conservation policies and financial incentives.

4.1.1. Energy conservation policies

Before the 1990s, the objective of most energy policies was to enhance national energy security by securing an adequate supply to meet industrial needs (table 9.4). Recently a handful of countries like China, the Republic of Korea, India, and Thailand have adopted legislation on EE or conservation. In China, improvements in EE are directly addressed in the 2007 Energy Conservation Law, which stipulates that enterprises should use clean energy technologies and mandates industrial authorities to issue a list of obsolete energy intensive equipment to be retired permanently from the production system. The Republic of Korea's Rational Energy Utilization Act is similar to a law promulgated by Japan in the 1970s, which aims to stabilise energy demand, creates incentives for the efficient use of energy and promotes the development of energy-related technologies. The Energy Conservation Act of 2001 in India promotes EE by specifying energy conservation standards and labelling requirements for industrial equipments and prescribes energy audits for energy intensive factories. Thailand enacted the Energy Conservation Promotion Act in 2002 to provide a regulatory framework for EE and conservation investment in factories across different sectors under public-private partnership audit programmes.

Table 9.4. Energy efficiency policies in selected Asian countries

Policy Type	East Asia					South east Asia					South Asia		
	China	Hong Kong	Japan	The Republic of Korea	Taiwan	Indonesia	Malaysia	The Philippines	Singapore	Thailand	Vietnam	India	Sri Lanka
Country Strategy	○		○	○			○	○		○		○	
National energy policies	○		○		○	○	○				○	○	○
Regulatory instruments	○		○	○	○			○		○		○	
Energy audits			○		○					○		○	
Energy conservation fund			○							○			
Financial incentives			○	○	○		○	○		○	○	○	
Tax incentives			○	○			○	○	○				
Energy performance standards	○		○	○	○		○	○		○			
Mandatory product labels			○	○				○		○			
Voluntary product labels	○	○	○	○	○	○			○	○	○	○	○

Experience from 11 Asian countries shows that industrial customers who received audits reduced their electricity use by an average of 3-7%, with higher energy savings achieved when the factories followed the recommendations (Ming 2006; Cogan 2003; UNEP 2002b; UNEP 2006b; UNESCAP 2004; UNIDO 1997). The Indo-German Energy Efficiency Project in India proved that when 50-60% of the recommendations were implemented, energy savings in the order of 5-15% were possible (Kumar et al. 2005).

Mandatory energy performance standards appear to be the most widely adopted process tools across newly industrialised countries. In Taiwan, for example, mandatory EE standards were established for industrial products like motors, boilers, transformers, water chillers and heating, ventilation and air-conditioning systems. Typically, the standards call for EE of 5-25% greater than the average products in service (Nordquist 2006). While targets and standards have been introduced in other countries like China and Thailand, these measures have not been effective, due to factors such as unrealistic standards. Many Asian countries are following OECD standards, which are often too high to be applicable in developing countries (World Bank 1992). Setting standards for EE is not just a technical matter, but also involves checking and creating an enabling environment for the wise use of energy. Company considerations such as technology, costs, and awareness, which induce industrial behavioural change, are different in developing Asia and simply adopting OECD standards will not be effective.

The lack of institutional capacity is another factor. Most energy conservation departments operate with few personnel and limited resources. Inadequate institutional coordination is also problematic in many Asian countries. In Vietnam, Electricity of Vietnam is implementing a national energy conservation programme, while the Ministry of Industries is providing financial incentives for factories to deploy EE technologies, but there are no links between the two programmes. The budget for the Bureau of

Energy Efficiency in India is only 0.3% of potential EE investment in the electricity sector. There are successful institutions, of course, like the Korea Energy Management Corporation, which is the lead agency in EE, dissemination of technology and climate change mitigation. Its coordinated efforts to establish standards and provide adequate financing to industry resulted in EE improvements in the order of 40-50% in key sectors like steel and cement. Hence, to improve EE, it is essential for governments to review the existing policies and institutional structures, and analyse successful working models to set and implement effective standards and sector targets.

4.1.2. Economic instruments

Grants, low-interest soft loans and subsidies are popular policy measures, provided by the government to industry as incentives for improved EE. These measures are often combined with an extended pay-back period, making them very attractive. Special funds were set up in some countries to activate sector level actions. In Thailand, for example, a revolving fund was established to develop an EE finance market. Similar funds in India use public finance to help industry make better investments in energy consumption and train staff for EE. Another example is the energy conservation loan programme being implemented by China, which requires industries to commit 7-8% of total investment to improve EE. Since its inception in the 1990s, this programme has stimulated widespread uptake of energy efficient technologies. As a result, energy consumption slowed down at a rate of 4.8% per year during the last decade, compared to 7.5% in the previous decade, while GDP continues to grow as fast as 9.5% (Xia 2003).

A few countries like the Republic of Korea, Singapore, and Malaysia are experimenting with the use of disincentive systems, such as energy taxes, to achieve higher efficiency and the economic and environmental benefits that come with it. However, such systems face difficulties in achieving the targets due to the low fee structure and lack of incentives. Emitting industries in the Republic of Korea are prepared to pay the low fees, rather than invest in EE. Opponents of market-based instruments argue along the lines of competitiveness, fearing that domestic industries would be wiped out by multinationals if such disincentives are introduced. Targeting other economic incentives such as tax credits and depreciation have also been a challenge in several countries. Incentives suffer from a free rider problem, where incentives support investment such as deployment of technologies that would have been made anyway. Identification and effective targeting of clearly defined industrial beneficiaries is needed in designing new economic instruments to promote EE.

Many Asian countries remain plagued by heavily subsidised oil prices. Several energy experts believe that until these subsidies are significantly reduced or even removed, other incentive mechanisms will not fully work (Sathaye and Bouille 2001; Kasahara et al. 2005; Intrachoto and Horayangkura 2007). Governments of developing countries in Asia are often faced with an uncomfortable trade-off between the environmental and social effects of reforming subsidies. Occasionally there are good reasons for retaining an element of price subsidy to improve the social conditions of weaker groups. In recent years, however, many governments have started reviewing the validity of subsidies as concerns grow about the environmental consequences of encouraging excessive energy use. Japan has phased out all subsidies for coal since the 1980s. In 1992, China decided to open the market for coal and abolished the subsidies to state-run coal companies. Successively, the product tax of 3% was replaced by a value

added tax of 13% and the total coal subsidy was reduced from \$750 million in 1993 to \$240 million in 1995. These measures helped to reduce coal use in China by 5% between 1997 and 2001. In summary, there is a need to review perverse subsidies to ensure that socio-economic benefits do not need exceed environmental costs.

4.2. Actions taken by the private sector

The private sector in Asia is undertaking voluntary action, either unilaterally or in agreement with governments, to implement EE measures as a way to gain recognition, achieve financial and social benefits, and to stave off the possibility of stricter regulations.

4.2.1. Unilateral voluntary certification programmes

One type of unilateral environmental voluntary commitment is the adoption of ISO14000 standards. Even though they do not have the force of law or government policy, in many cases the ISO 14000 series is becoming the *de facto* codes of practice as the market recognizes the value of such voluntary approaches. Since its launch in 1999, the uptake of ISO 14001 has been rapid in Asia and it has become the most commonly used quality assurance metastandard. Asian corporations comprise approximately 40% of the world's ISO 14000 certified companies. As of December 2007, Japan leads with 13,104 certificates, followed by China (8,865), the Republic of Korea (2,610), India (1,900), Taiwan (1,463), Thailand (974), Singapore (573), Malaysia (566), Indonesia (369), and the Philippines (312), showing widespread uptake across the region. ISO certification is usually awarded to a production facility under the condition that it complies with a set of environmental performance criteria. EE requirements are part of the criteria to encourage factories to engage in a continuous improvement process. The impact of such programmes on SMEs is an important consideration. In many cases, such as engineering spare parts, steel casting works, brick kilns and others, SMEs have difficulty in meeting international EE and environmental standards because they do not have the necessary capital resources. Reaching these small companies and providing special support to adopt voluntary environmental management systems need urgent attention, not only for climate change reasons.

4.2.2. Bilateral cooperation between businesses

Business-to-business cooperation is rapidly emerging in increasingly globalised Asia. Asian companies in global supply chains receive peer pressure from multinational companies (MNC) to improve their energy performance. MNCs with strong brand name reputations are under intense pressure from customers, regulators, and investors to transfer home country environmental standards to their suppliers in the developing countries of Asia. The MNCs are willing to provide technical assistance to ensure that neither they nor their suppliers are subject to criticism by consumers while collectively improving their environmental and energy performance (box 9.5). Planned in the right way, environmental requirements by MNCs on developing country suppliers could have the same effect as national environmental regulations and trigger innovations (ADB 2005).

Box 9.5. Supply chain management of Toyota Motor Corporation

TOYOTA Green Purchasing Guidelines

Toyota issued its environmental purchasing guidelines in 1999. In March 2006, Toyota reviewed and revised the Environmental Purchasing Guidelines, which request suppliers to proactively promote environmental initiatives. The new guidelines were named the “TOYOTA Green Purchasing Guidelines”. The major revisions are (i) in addition to requests to implement environmental initiatives, items with regard to the social aspects of supplier business activities have been included; (ii) initiatives that were begun after the initial purchasing guidelines had been issued (such as responses to the EU ELV1 Directive, responses to Eco-VAS 2 and environmental initiatives during logistics activities of contracted transportation companies) have been included; (iii) against the background of Toyota’s globally expanding environmental initiatives, suppliers are asked to implement environmental measures like CO₂ emissions reduction, in their production activities; (iv) to further reduce CO₂ emissions during logistics operations, suppliers are asked to implement environmental initiatives in their purchasing and logistics activities. The recent revision also expanded the scope of supplier categories targeted. Approximately 550 suppliers of equipment, and construction and logistics services were added to the existing list of parts and materials suppliers, increasing the total number of companies covered by the new guidelines to about 1,000. Toyota plans to gradually expand the application of the revised guidelines to the newly included suppliers through consolidated companies in Japan and overseas. By these measures and other approaches, the company has reduced its CO₂ emissions substantially.

Source: TMC (2006)

4.2.3. Voluntary agreements

New approaches to improving EE at the sectoral level include voluntary agreements, which are contracts between a private company or an industrial association and the government. The scope of the agreement can vary, but essentially the private sector promises to attain a certain level of EE improvement within a specified time frame. Business associations of industrialised countries like Japan have adopted such voluntary agreements as a self regulating form of EE improvement (box 9.6). To date, more than 3,000 such environmental and pollution control agreements are being negotiated between the Government and companies in Japan. In return, governments promise to refrain from imposing strict regulations, in the broader interest of industrial growth.

There are few examples of such negotiated agreements in other economies of Asia (ADB 2005), but such voluntary agreements could play an important role in climate change mitigation in the future. While companies can use the voluntary commitments to acquire recognition and other regulatory benefits, governments can target the reduction of GHG emissions with a carrot and stick strategy. Intensive stimulation and design of appropriate incentive mechanisms would make business associations more willing to act upon such voluntary efforts.

Box 9.6. Japan steel industry's Voluntary Action Plan

Japan's most prominent business association, Keidanren, declared a Voluntary Action Plan on the Environment in 1997. In the plan, individual firms are bound within their respective industrial associations to cut emissions. This means that the commitments, of which emission targets are the most significant, are set at the sectoral level; not by individual firms which try to continuously improve their EE measures. As part of the Plan, the Japan Iron and Steel Federation (JISF) devised its own action plan to reduce energy consumption by 10% for the year 2010 compared to 1990 levels. Measures implemented consist of (i) energy savings in the iron and steel making process; (ii) effective utilisation of plastic and other waste materials; (iii) energy savings through steel products and by-products; (iv) energy savings through international technical cooperation; and (v) utilisation of waste energy in areas around steelworks. At the end of 2006, 68 companies were participating in the programme, accounting for 97.4% of energy consumption within the industry. To date, the steel industry's energy consumption shows a 6.9% reduction from 1990 levels.

Source: Yamada (2007)

4.3. Actions taken by intermediaries

Several intermediaries are already helping industry to tackle the technology, finance and managerial barriers associated with climate change in Asia. Specific actions include the following.

4.3.1. Energy service companies

In recent years, Asia has witnessed the emergence of companies that supply EE solutions and are paid from the energy savings achieved. ESCOs are emerging as a response to the unavailability of technical expertise at factory level and lack of project financing. Also, there is a great need for such intermediaries by SMEs, as it is often impractical or prohibitively expensive for small companies to identify, assess and implement the technological improvements by themselves. ESCOs help their industry clients to improve EE by designing and installing energy efficient equipment, financing energy efficient projects and providing risk guarantees for energy savings. Japan is leading the region with more than 1,300 ESCOs. The World Bank and Asian Development Bank (ADB) are instrumental in promoting ESCOs in countries where energy markets are in transition. From 1998, with the cooperation of the World Bank, China has promoted around 400 energy management companies, providing EE audits and services at no initial cost, but with a performance based contract for later payments. Since 2003, the ADB has provided funds for ESCO activities in India (box 9.7), Malaysia, the Philippines and Thailand to catalyse business opportunities in the EE markets.

In spite of their key role, private banks are reluctant to finance ESCO operations until performance contracting has been successfully demonstrated, thus limiting the uptake of such services by SMEs. Policies to strengthen the financial capacity of ESCOs to develop and implement projects will have an important impact on EE gains by SMEs in Asia.

Box 9.7. Energy service companies in India

India has a small but growing community of ESCO entrepreneurs. Some of India's first ESCO demonstration projects implemented through performance contracting and guaranteed savings include (i) energy-efficient lighting retrofitting for the New Delhi Municipal Corporation facility, which resulted in a 48% load reduction, from 264 to 138 kWh; (ii) a demand-side management programme for a public electric company that resulted in savings of 5.04 million kWh/year; and (iii) a 135-room five-star hotel in Hyderabad which saved 25% of the hotel's annual energy bill. Indian ESCOs typically do not have large assets to bank upon. Therefore, while they have the technical capability to identify and custom-design projects that deliver energy savings, they are often unable to convince their clients, investors and bankers about the certainty of delivering those savings.

Source: Cherail (2007)

4.3.2. Multinational joint venture companies

Technology transfer from industrialised economies to developing Asia is also happening in the form of joint ventures (JV) by MNCs. FDI in countries like China, India and Vietnam swelled about ten times compared to the 1980s and most MNCs are concentrated in automobiles, electronics, chemicals, and petroleum and mining. The production technology of MNCs is more energy efficient than domestic companies and is often used as a prime vehicle for technology transfer and modernizing obsolete facilities. Since domestic companies tend to be recipients of capital, the transfer of technology depends on the market power of the MNCs and IPRs. Strong protection of IPRs can improve technology transfers through JVs. Achieving success in this area also relies on the negotiating skills of domestic companies, international agreements, and government inputs to enable the legal framework.

Organisations like the World Business Council for Sustainable Development (WBCSD) are active in formulating new initiatives such as the Eco-Patent Commons, a mechanism by which businesses pool and provide free access to environmentally beneficial patented processes, such as production processes that conserve energy. IBM, Nokia, Sony and Pitney Bowles are the first four businesses to participate in the Eco-Patent Commons and have collectively donated thirty-one patents. A driver behind the initiative was to reduce barriers created by IPRs in the transfer of technologies between companies and countries, and to open access to environmentally sound technologies for developing countries.

4.3.3. Research and development support for SMEs

Many supportive measures are being undertaken by intermediaries to improve the energy performance of SMEs. Financing schemes such as the countryside loan fund of the Land Bank of the Philippines, the Small Industrial Development Bank of India and the National Development Bank of Sri Lanka target SMEs to adopt EE measures through concessional loans. Policymakers and industry representatives point out that the direct costs and transaction costs of imported technologies, even with financial support from banks, are still prohibitively high and often not compatible with local conditions.

Countries like China and India have excellent capacities for science and technology research, but research on energy efficient technologies that suits small-scale business operations has not been given priority. The research and development (R&D) funds allocated to EE technologies are only a fraction of the total industrial technology research. Moreover, inadequate attention is paid to domestic R&D of innovative and cost-effective technologies and transfer from laboratories to industry (Yoshi and Yokobori 1997). Strengthening local R&D is especially important for technologies that are not produced internationally but meet the needs of SMEs.

4.3.4. International development assistance

International support for Asian industries to improve EE is also provided by bilateral official development assistance (ODA) programmes and by multilateral development banks (table 9.5).

Table 9.5. Bilateral and multilateral cooperation on energy efficiency

Project	Type of aid	Target sector	Lending organisations	Time frame
Energy Efficiency Training	Technical assistance, capacity building	Industry, government	JICA	1980s – present
Green Aid Plan: Energy Efficiency Projects	Technology development	Industry (steel, cement, chemical), electric power	METI and NEDO	1992 – present
Dalian Energy Centre	Technical assistance	Industry	MOFA, JICA, ECCJ	1992 – 1998
Energy Conservation Centre, Thailand	Technical assistance	Government, Industry	METI, NEDO, JICA, ECCI	1999-2005
Industrial Boiler Project, China	Technical assistance, Technology Development, Market development	Boiler manufacturing industry	World Bank – Global Environmental Facility	1995-2004
Chiller Replacement Programme, Thailand	Technical assistance, market development	Chiller Manufacturers	World Bank – Global Environmental Facility	1998-2003
China Energy Conservation and Resource Management project	Technical assistance	Government, Electric power, industry	ADB	2005-present
China Industrial Energy efficiency	Technical assistance, technology development	Industry (chemical, cement, steel)	ADB	1996-2001
Energy efficiency Fund	Technical assistance, market development	Diverse	ADB	2006 - present
ESCO Fund	Technical assistance, market development	ESCOs, industry, buildings, public/government	ADB	2003 - present

Countries, like Japan, that are more energy efficient help industrialising countries of the region through technical and economic cooperation. The Japan International Cooperation Agency (JICA), the Japan Bank for International Cooperation (JBIC) and the Ministry of Economy, Trade and Industry (METI) are instrumental in sending technical experts and offering low-interest loans for EE investment. Major recipients of ODA for industry are in low-to-medium income countries.

The Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific (GERIAP) project is an initiative by UNEP to assist Asian companies to become more energy- and cost-efficient through strategies that improve EE, prevent carbon emissions and reduce operational costs. More than 40 companies from the cement, chemicals, ceramics, steel and paper sectors have participated in this pilot project in Bangladesh, China, India, Indonesia, Mongolia, the Philippines, Sri Lanka, Thailand and Vietnam. By undertaking EE measures, participating companies have reduced emissions by more than 85,000 tCO₂e/yr, while making annual profits of more than \$4 million (UNEP 2002b).

Multilateral agencies like the World Bank and the ADB are sponsoring projects on demand side energy management, focusing on electrical power supply and chemical, cement and steel industries. Their current strategy of project-based, government-chosen technology transfers, however, is often found to be slow and inflexible. More emphasis could be given to business-to-business cooperation as well as building the capacity of institutions to make sound policy decisions.

5. Conclusions and recommendations

5.1. Recommendations

EE is of equal interest to business and government. In a recent worldwide survey, 60% of 2,192 corporate executives regarded climate change as strategically important (McKinsey 2007) and many companies have prepared strategies to curtail their own GHG emissions. The recent increase in oil prices highlights the business case for investing in EE options. As business has to provide the largest share of GHG reductions, national performance in mitigating climate change depends on helping them to improve EE. Several studies (AIT 2007; Hward and Vallery 2007; Kainuma et al 2003; UN 2004) indicate that developing countries in the Asia-Pacific region can save 25-30% of their energy use with the current state of technology and level of industrial development. The benefits of EE can be further enhanced by using renewable energy sources such as wind, solar power or bioenergy as well as cleaner and more efficient coal technologies. With significant investments in EE, savings may go as high as 60% in key manufacturing industries (APO 2001). However, uptake of effective and efficient energy production processes and technologies are hampered by policy, as well as financial, managerial, and technological barriers. Asian governments, the private sector and other intermediaries are making efforts to overcome these barriers and improve the energy performance of industries. Case studies have demonstrated that focused business efforts combined with appropriate policy instruments can yield greater energy savings.

Addressing all barriers may not be possible by a single approach and so a combination of prioritised approaches by different actors should be formulated, starting from the immediate concerns with low-cost solutions. Considering the urgency of tackling GHG emissions and recognizing the potential contribution of EE improvements, immediate action should be undertaken across the region. The key element in effective EE strategies is implementation of combined actions in a parallel, coordinated and consultative manner. Priority recommendations include the following.

(i) *Placing EE at the centre of development policy* - Governments in Asia should place EE at the centre of industrial development policy, as it yields quick, tangible environmental and economic benefits. Bringing EE to the centre, however, needs close coordination among relevant government departments like industry, energy, environment, trade and business associations. They need to agree on common objectives, which will necessitate a systematic review of key sectoral policies. At the beginning of each fiscal year, existing policies, programmes and action plans can be adjusted so that they support, or at least do not conflict with, government efforts to integrate EE into developmental policies. This annual review could be undertaken by relevant ministries, overseen by a lead agency responsible for drafting integrated energy action plans.

(ii) *Setting progressive standards and benchmarks* - Asian governments need to think of new standards and sectoral benchmarks that could provide improved market signals for EE. For sectors that consume or waste significant amounts of energy, competitive targets for the best environmental performance should be set up based on international standards. Many studies suggest that the most effective way to achieve sectoral targets is to establish progressive energy performance standards through collective efforts and mandating audit programmes. Tight standards, ambitious targets and liberal incentives will also stimulate innovation at the company level, which would ensure a natural turnover of obsolete production processes. Annual plans should review the success of measures taken during the previous year, in terms of energy saving and cost-effectiveness, as a basis for setting new targets. These targets and standards could be accompanied by voluntary agreements by business associations or public-private partnership accords, with the implied threat of mandatory programmes if voluntary approaches are not effective.

(iii) *Promoting better use of subsidies and state aid* - Public policies could continue their use of targeted subsidies to support energy-efficient technologies and production processes. Specific initiatives such as tax credits and accelerated depreciation for energy efficient technologies and servicing models have been found to be effective at removing the barriers to EE by reducing the investment pay-back periods and minimising the perceived performance risks. State subsidies that depress the price of energy can provide a significant disincentive for EE investments by industry. If such price controls were made more market-responsive, a more favourable investment climate could be created to encourage EE.

(iv) *Accelerating private sector voluntary actions* - Asian business efforts to become the world's most competitive companies depend on tackling EE issues. In light of the challenges posed by climate change, industrial ability and economic stability cannot be achieved without major advances in responding to calls from global market forces. Industries in Asia must be prepared to enter into voluntary agreements with the government to set standards and targets for energy efficient production processes and to reduce the market share of the least efficient processes. Integrating voluntary environmental management standards such as ISO 14000 into operational policies could provide a new impetus to EE. New supply chain partnerships, JVs and FDI need to be accompanied by targeted actions to improve EE.

(v) *Stimulating the role of business associations* - Business associations in key industrial sectors should enter into agreements with governments to save energy and reduce GHG emissions in exchange for access to low-interest loans to finance EE

investments and guarantees of stable policies. High energy-consuming sectors can learn from the experience of better performing economies which have witnessed a growing number of voluntary action plans to reinforce sectoral level investments in EE. Business associations should also collect best practices on a regular basis for dissemination by networking with counterpart associations in OECD countries and the WBCSD. Setting sectoral targets and benchmarking product standards could be one of the objectives of establishing such databases. Establishing one stop energy centres for receiving information on best practices, technologies, finance and training has the potential for widespread dissemination of best business practices. Such institutions could be established as a public-private partnership in the initial stages, but become self-supporting later.

(vi) *Special support for SMEs* - SMEs face a myriad of problems. They could be addressed by a single window system, wherein a specialised institution with sufficient resources could assess their technology needs and finance EE improvements. This would avoid the ambiguity of the present system with separate technology evaluation and financial assessment. Moreover, research and development policies should be made consistent and coherent with financial and technological policies that promote EE in SMEs. Increased public and private investments on domestic research, as well as transfer of technologies from laboratory to industry, will allow Asian SMEs to develop more appropriate energy efficient technologies that meet their needs. Research investments in limited but key sectors may provide huge cost savings if the technology is proven successful and sold to neighbouring countries. ESCOs could play an important role in improving the EE of SMEs. Current financial schemes for employing ESCOs need careful review and appropriate adjustments. There is an immediate need to revise the legal framework for bankable projects, and also to develop innovative financing products and deal structures. These steps would work towards reducing transaction costs, which could also mitigate project implementation risks. Revision of the legal framework for bankable projects and development of innovative financing products and deal structures to reduce transaction costs that could also mitigate project implementation risks are an immediate need. As EE lending is a new business for the financial institutions involved, capacity building of banking staff to understand the unique nature of SMEs and the importance of energy saving is also an urgent need.

(iv) *Integrating EE in international cooperation* – The current international framework for improving investment in EE is inadequate. Bilateral and multilateral aid agencies, which command strong resources and technical expertise, are always well placed to overcome the inherent barriers to improved EE. They should aim to create green lead industries in developing Asia. Green lead industries set high energy performance standards that can be subsequently adopted in other companies in the same sector or other countries. Creating lead green industries requires long-term and ambitious policies as well as technological leadership. Bilateral, multilateral and international organisations could help developing countries in Asia in analysing and prioritising the barriers, selecting key sectors for strategic support for leapfrogging and developing action plans. With support from the international business community, they can create innovative financial mechanisms, such as a seed capital assistance facility, currently being promoted by the UNEP.

5.2. Future research agenda

As there is little doubt that EE not only contributes to reduced GHG emissions, but also to bottom line business profits and national energy security among others, a lack of information appears to be a major barrier to more widespread adoption. Accordingly, the future research agenda should focus on collecting detailed case study data from all sectors and all company sizes on successful EE implementation. In particular, the effectiveness of internal and external energy audits in Asian companies, supply chain partnership programmes, and foreign direct investment needs additional research.

As governments may be concerned that additional support to industry in the form of seed funding to initiate company wide EE plans could be criticised as being too pro-business, the multiple co-benefits of EE (employment creation, clean air, health effects, energy security, start up industries etc.) also need to be documented through additional research. EE is not only good for business; it is also good for the economy, the environment, and the community—all of the elements of sustainable development.

Asian governments generally spend very little on R&D, yet express reservations about IPRs and other barriers to the transfer of technologies from developed countries. Major increases in R&D expenditure on EE technology suited to local conditions, company structures, and Asian resource endowments would yield very high returns.

Finally, industrialised countries like Japan demonstrate that national GHG emissions would have been much higher had they not implemented EE programmes long before climate change was a burning issue. Developing countries in Asia now have an opportunity to emulate this success. Cooperative South-South research on policy transfer and diffusion in the field of EE would help to ensure that best practices in Asia are widely disseminated.

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PART III

| CHAPTER 10 |

CONCLUSIONS AND RECOMMENDATIONS



Chapter 10

Conclusions and Recommendations

Climate policy alone will not solve the climate change problem. Climate outcomes will be influenced not only by climate-specific policies but also by the development path chosen. Asia, which is already experiencing the adverse impacts of climate change, cannot afford to “wait and see” or follow the historic, unsustainable, carbon-intensive development paths of industrialised countries. Developing countries in Asia have an outstanding backlog of sustainable development and poverty reduction priorities, into which climate change mitigation and adaptation policies must now be integrated. Since much of Asia’s energy and material infrastructure will be built over the next few decades, regional policymakers and investment agencies should pursue a low carbon, climate resilient developmental path and ensure that climate change concerns are fully considered in all infrastructure investments.

The Bali Action Plan calls for consideration of nationally appropriate actions (for mitigation and adaptation) by developing countries in the context of sustainable development, enabled and supported by technology, financing and capacity building. Accordingly, the recommendations of Parts I and II of the White Paper are organised around these elements. In general, the Institute for Global Environmental Strategies (IGES) recommends that Asian countries should work together to formulate a post-2012 regime that (i) is characterised by a multi-stage, multi-track framework with differentiation of countries based on national circumstances, responsibility, capacity, mitigation potential, and adaptation needs, and (ii) includes progressively increasing emission reduction and adaptation commitments or actions, and differentiated financial and technological incentives and compliance provisions.

Mitigation

Asia offers many low-cost, effective mitigation opportunities. With increased incentives, streamlined clean development mechanism (CDM) processes, effective transfer of new technologies, a broader range of market mechanisms and carefully nuanced enabling policies, Asia can be expected to make a significant contribution to global climate change objectives. Specific recommendations include:

- (i) Ensure that the future climate regime effectively capitalises on the strengths, and overcomes the weaknesses, of the Kyoto Protocol and that any other approaches and actions outside that regime are complementary.
- (ii) Develop and quickly implement a multi-pronged approach to addressing the climate change impacts in developing countries of Asia, as the costs of inaction or delayed action will be several times higher than the costs of action.

- (iii) Identify and exploit widely available low-cost mitigation opportunities by initially enhancing energy efficiency (EE) and promoting renewable energy (RE), and then phasing in more advanced low carbon technologies.
- (iv) Ensure that all energy intensive industries in Asia prepare and implement a vigorous EE strategy, as this could enable greater GHG emission reductions than any other short term climate change option.
- (v) Strengthen the CDM through (a) simplified methodologies, inclusion of additional sectors, programmatic and sectoral approaches, and national policy-based approaches; (b) provision of a credible signal that the CDM will continue to ensure value for certified emissions reduction (CER) beyond 2012; and (c) multi-source funding to broaden funding sources and spread the financial risks of CDM projects among several institutions.
- (vi) Promote other types of market mechanisms for mitigation, including voluntary carbon markets, as the reduction in GHG emission trajectories in developing countries will be too small, even if all CDM pipeline projects are implemented.

Adaptation

Climate extremes already take a terrible physical and human toll on the Asia-Pacific region and global climate change will make the situation worse. A “wait and see” attitude to climate change is no longer tenable and “no regrets” adaptation measures need to be implemented now. Specific recommendations regarding adaptation include:

- (i) Facilitate mainstreaming of climate change adaptation into economic development programmes, including agricultural development plans, by creating reliable capabilities for quantitative vulnerability assessment and adaptation planning, establishing improved metrics and standards, documenting best practice examples, improving capacities in developing countries, and requiring all major development policies and measures to undergo adaptation screening.
- (ii) Enhance the resource base to support adaptation efforts by (a) effectively involving the private sector; (b) carefully building adaptation measures on existing indigenous coping strategies, where applicable; and (c) promoting measures such as flexible farming systems, improved disaster preparedness and public awareness, early warning and monitoring systems, hazard mapping and asset inventories, reforestation, engineering of structures in coastal areas, and land use planning.
- (iii) Mainstream adaptation measures into water resource development and management plans, strengthening existing water resource management systems and measures to cope with potential impacts of climate change (such as increasing groundwater volumes stored in aquifers).
- (iv) Diversify water sources, improve water-related infrastructure, and conserve water to minimise the risks of more frequent and prolonged droughts.

Integration with sustainable development

In some quarters there has been an unfortunate tendency to treat climate change and sustainable development as if they were separate domains of human endeavour. The White Paper findings reinforce the conclusion that climate change must be addressed within the overarching context of Asia’s sustainable development priorities. Asia needs

to ensure that (i) the global post-2012 climate change regime reinforces sustainable development efforts; and (ii) domestic and international efforts to achieve sustainable development in Asia contribute to reduction in GHG emissions. Specific recommendations include:

- (i) Implement integrated development and climate strategies by linking climate policies with related multilateral environment agreements (MEA), measures designed to achieve the millennium development goals (MDG), and national energy plans, while building synergies with policies in non-energy sectors.
- (ii) Design a post-2012 regime that reconciles global climate objectives with Asia's sustainable development priorities and treats mitigation, adaptation, technology and financing in a more balanced manner.
- (iii) Create mechanisms to recognise and support the synergies between sustainable development benefits, climate change adaptation and GHG mitigation including maintenance of a registry of best practices.
- (iv) Strengthen the assessment of each CDM project's contribution to sustainable development and devise a system that provides a premium to those projects that may have low CERs but high developmental co-benefits.
- (v) Visualise a low carbon future for Asia, by basing national energy strategies on a thorough reassessment of alternative energy potentials through a comprehensive inventory of natural resource endowments.
- (vi) Place EE at the centre of industrial development policy, as it yields quick, tangible environmental and economic benefits.
- (vii) Prevent direct or indirect conversion of peat land and tropical forests in Asia to monoculture biofuel crops.
- (viii) Ensure that biofuel production from food crops does not result in unaffordable basic food prices for the poor in developing Asia.
- (ix) Check that the land is not used by the landless poor for livestock grazing or other purposes when considering "wasteland" for non-food oil crops like jatropha for biofuels.
- (x) Formulate policies to encourage labour intensive production methods for biofuels while ensuring the health and safety of workers.

Technology

There is no single "silver bullet" technology that will overcome global climate change, but there are many promising technologies that will contribute to the solution. The challenge is to ensure that development of these technologies is accelerated through expanded research programmes and then rapidly transferred to developing countries. Barriers to the accelerated deployment of promising technologies need to be overcome through partnerships at many levels. Specific recommendations include:

- (i) Facilitate the development, transfer, and deployment of low carbon technologies in developing countries of Asia by actively promoting synergies with technology initiatives outside the climate regime and engaging in early stages of low carbon technology development to lead to joint ownership of intellectual property rights.
- (ii) Even though the environmental and other benefits of second generation biofuel technologies (especially from waste organic matter) are expected to be significantly higher than those of first generation ones, further research in Asia is necessary on both technological options and the extent of their benefits.

(iii) Consider composting, which is less harmful to the environment and has multiple co-benefits, as a possible alternative (under appropriate local conditions), to upgrading municipal waste treatment systems from open dumps to landfills, which may reduce local environmental impacts but add (marginally) to global methane emissions.

(iv) Use centralised composting of market wastes (without any intention to profit from the sale of the product) as a suitable model for local governments to gain experience in alternative waste management practices.

(v) Use tight standards, ambitious EE targets and generous incentives to stimulate technological innovation at the company level, and ensure natural turnover of obsolete production processes.

(vi) Leverage supply chain partnerships and foreign direct investment to improve access to advanced EE technologies available in OECD countries.

Finance

The cost of inaction on climate change far outweighs the cost of action. Therefore, there should be no absolute constraint in providing funding to combat climate change. There are barriers in ensuring that funds are applied where they can do the greatest good, however. Misplaced subsidies promoting first generation biofuels is one example drawn out in the White Paper. Innovative financing options, the leverage of financing institutions and the power of markets need to be creatively combined in Asia to generate long term climate change benefits. Some specific recommendations outlined in previous chapters include:

(i) Promote innovative financing options (such as carbon taxes, “green” procurement, or a regional technological development fund) to make the currently available low carbon technologies commercially viable, and create funding mechanisms to acquire and deploy low carbon technologies.

(ii) Broaden funding support for climate change mitigation and adaptation beyond the narrow confines of the CDM through initiatives of the multilateral financial institutions, the insurance industry, and venture capital, among others.

(iii) Require further identification and systematic addressing of the barriers to investment in more comprehensive EE programmes in developing countries by governments, business, and development partners.

(iv) Require public policy initiatives such as tax credits and accelerated depreciation for energy efficient technologies and servicing models to remove the barriers to EE by reducing the investment pay-back periods and minimising any perceived performance risk.

(v) Reach small and medium enterprises by a specialised institution with sufficient resources that can assess their technology needs and provide up-front financing of EE improvements and ongoing technical assistance.

(vi) In the forest sector, select a mix of non-market and market mechanisms which incorporates sustainable development concerns, protects forest dependent communities and ecosystem services, and does not rest on price alone.

(vii) Defer introduction of stronger biofuel promotion policies, such as increased fuel blending requirements, production targets, subsidies, or tax incentives unless there is a reasonable assurance that biofuels can be sustainably produced.

Capacity building and institutional strengthening

Leadership, strong institutions, enhanced negotiating and implementation capacity, and effective inter-agency coordination are within reach throughout Asia, but additional capacity building is needed. Some specific recommendations include:

- (i) Demonstrate leadership by policymakers and politicians in Asia by moderating the growth of GHG emissions in the near term and putting in place a comprehensive plan of action for changing the region's emissions trajectory by no later than 2012, with a view to achieving a near-term peak and eventual reduction in emissions.
- (ii) Institute a well-structured inter-agency coordination committee, headed by the country's leadership, to deal with climate change as a cross-cutting, multi-sectoral challenge to the nation's economy, environment, and society.
- (iii) Strengthen the negotiating capacity of developing Asian country delegations, so that they may be fully engaged in the future global climate change negotiations.
- (iv) Make sectoral agencies responsible for mitigation and adaptation policies and measures specifically affecting their sectors.
- (v) Draft laws and regulations on climate change, covering fundamental principles, rules and norms, and integration of climate change into sustainable development.
- (vi) Prepare national action plans to guide integrated sectoral and local implementation of climate change responses.
- (vii) Retain the flexibility of climate policies to accommodate the continually evolving nature of climate change, but be firm enough to withstand opposition from vested interests.
- (viii) Strengthen institutional frameworks and incentive mechanisms to recognise and reward developmental co-benefits of climate actions at local, national and international levels.
- (ix) Pay serious attention to forest governance and tenure and the livelihood needs of forest dependent communities in the design and implementation of reduced emissions from forestry projects.
- (x) Reform institutional arrangements to promote adaptation options in planning and implementation of groundwater management and integrate effective climate change response policies into comprehensive water management plans.
- (xi) Promote and support local groundwater management to reduce the burden on central governments.
- (xii) Institute improved systems of allocating groundwater use rights, effective charging regimes, and volumetric monitoring.

Multi-stakeholder participation

Climate change is a complex issue and multiple stakeholders in Asia need to work together as partners to find acceptable solutions. Some specific recommendations to enhance multi-stakeholder participation include:

- (i) Involve the entire community in climate change responses, with well established mechanisms to mobilise and empower stakeholder participation.
- (ii) Change perceptions so that there is a shared sense of responsibility and affiliation among all actors trying to solve climate change problems in Asia.
- (iii) Incorporate GHG emission accounting and carbon footprints not only in company reports, but at the household, community and municipal levels, with the

information disseminated widely throughout Asia.

(iv) Use multi-stakeholder processes and independent standards by accredited third party organisations to ensure positive social, environmental and economic outcomes of climate change projects in rural areas.

(v) Introduce carbon sequestration into community-based forest management models through REDD demonstration activities, paying attention to equitable distribution of benefits between government and the community, and within communities.

(vi) Clarify the expectations of each stakeholder group and evaluate how different models can meet those expectations for composting of household waste.

(vii) Provide timely and accurate information by the media in Asia on how individuals, companies and various groups can contribute to climate change solutions.

(viii) Increase involvement of Asian NGOs in international climate change policy forums and negotiations, intermediating between grassroots activities and national policy positions.

(ix) Strengthen the role of research institutes and universities in mobilising public support to tackle climate change, monitoring the effectiveness of mitigation and adaptation measures, and evaluating success factors of climate change policies, programmes and projects. Monitoring and evaluation activities by research institutes and universities should be supported by governments and international organisations.

Research priorities

The uncertain extent and pace of climate change, the scope of potential future impacts, and the cost-effectiveness of multiple mitigation and adaptation options are often cited as barriers to short term responses to climate change. While the collective efforts of the Intergovernmental Panel of Climate Change and hundreds of associated researchers are gradually eliminating the uncertainty that worries policymakers, more research needs to be carried out in Asia and more Asian researchers need to become involved. Specific research priorities include the following:

(i) Downscaling global climate models to regional, national and local levels, so that changes in key parameters like river flows, storm frequencies, incidence of drought etc., can be better predicted.

(ii) Evaluation of impacts on Asia's vulnerable ecosystems and transmission of vector-borne diseases.

(iii) Economic analysis of the costs of action versus the costs of inaction, at regional, national and sectoral levels.

(iv) Cost-effective hazard mapping, vulnerability and risk assessments, assets at risk inventories, and evaluation of potential sea level rise impacts and adaptation measures.

(v) Revision of codes and standards (like building codes, engineering standards, setbacks from high tide etc.) to accommodate climate change impacts.

(vi) Technological research and development in the fields of second generation biofuels, carbon capture and storage, EE, RE, waste management, water harvesting and others, specifically adapted to Asian needs and conditions.

(vii) Design and implementation challenges for the transition to a low carbon, climate resilient economy.

(viii) Elements of non-climate policies that also generate climate benefits, in

industry, energy, transportation, agriculture, forestry and other sectors, along with possible means to reward the climate benefits and accelerate sectoral development.

(ix) Potential linkages between climate policies and MEAs, such as the Convention on Biological Diversity, the Vienna Convention and its Montreal Protocol, the United Nations Convention on Combating Desertification, and the Basel Convention.

(x) Documentation of indigenous coping strategies in dealing with extreme climate events and how this traditional knowledge can be incorporated into modern mitigation and adaptation strategies.

(xi) Causes and effects of poor geographic and sectoral distribution of CDM projects in Asia and evaluation of measures to redress the balance.

(xii) Implications of the various targets and climate change regime proposals on Asia's social and economic development prospects.

(xiii) Likely costs and benefits, implementation challenges and verification problems of sectoral and policy-based, programmatic approaches proposed as possible improvements to existing CDM guidelines.

(xiv) Desirability and practicality of developing a separate global accord or protocol on climate change adaptation, including alternative funding and implementation arrangements.

(xv) Mapping of natural resource endowments (wind, solar, geothermal, wave, biomass etc.) in Asia that will potentially contribute to nationally appropriate low carbon society transition strategies.

(xvi) Costs and benefits of engaging communities in protecting forests and in monitoring carbon stocks, composting municipal wastes, and protecting groundwater resources, in comparison to other options.

(xvii) Additional comprehensive life cycle assessment studies of environmental, economic and social effects of biofuels, and development of more cost effective and environmentally sound ways to produce biofuels, especially second generation biofuels.

(xviii) Environmental justice and equity consequences of climate change policies, especially in the impact of climate change on groundwater resources, use of wasteland and/or food crops for biofuels, and exclusion of forest-dependent communities from forests protected for carbon sequestration.

(xix) Institutional research on why climate change has tended to be treated as a stand alone issue, rather than fully integrated into already established sustainable development institutions in Asia-Pacific.

(xx) Cooperative South-South research on policy transfer and diffusion, in climate change related areas like EE and RE, to ensure that best practices are quickly recognised and widely disseminated.

Overall

The one overriding policy recommendation of the White Paper is to ensure that climate change and sustainable development endeavours in Asia-Pacific are not permitted to diverge. Policymakers from the region should make this position, and its implications, abundantly clear in any future climate change negotiations. A sustainable development pathway for the Asia-Pacific region towards a low carbon, economically resilient society, in which poverty reduction, security, access to opportunities for all and a high quality environment are assured, must be a high priority goal.

