Green Growth, Resources and Resilience

Environmental Sustainability in Asia and the Pacific

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

ADB

UNEP

ESCAP promotes regional cooperation for inclusive and sustainable economic and social development in Asia and the Pacific, a dynamic region characterized by growing wealth, diversity and change, but also challenged with persistent poverty, environmental degradation, inequality and insecurity. ESCAP supports member States with sound strategic analysis, policy options and technical cooperation activities to address key development challenges and to implement innovative solutions for region-wide economic prosperity, social progress and environmental sustainability. ESCAP, through its conference structure, assists member States in forging a stronger, coordinated regional voice on global issues by building capacities to dialogue, negotiate and shape the development agenda in an age of globalization, decentralization and problems that transcend borders. A key modality for this strategy is the promotion of intraregional connectivity and regional integration.

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration. Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance. More information can be found at http://www.adb.org.

UNEP is the United Nations system's designated entity for addressing environmental issues at the global and regional level. Its mandate is to coordinate the development of environmental policy consensus by keeping the global environment under review and bringing emerging issues to the attention of governments and the international community for action. UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing and enabling nations and peoples to improve their quality of life without compromising that of future generations. UNEP's headquarters are in Nairobi, Kenya, and it has six regional offices around the world. It is one of only two UN programmes headquartered in the developing world. In Asia and the Pacific, UNEP works in 46 countries through its Regional Office for Asia and the Pacific located in Bangkok, Thailand. More information can be found at:http://www.unep.org.

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This publication follows the United Nations practice in references to countries. Where there are space constraints, some country names have been abbreviated. In the Asian Development Bank, China is referred to as the People's Republic of China and Kyrgyzstan is referred to as the Krgyz Republic.

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Foreword

The Asia and Pacific region faces a new economic reality, a development context that is increasingly influenced by resource constraints and growing risks. In recent years, convergent economic and environmental challenges have had dramatic impacts on millions of people, threatening continued progress toward reduction of poverty and hunger. High food, energy and commodity prices, persistent income inequality, and climate and environmental changes overshadow the regional outlook.

These storm clouds come with a tantalizing silver lining. Asian and Pacific countries have made "green" policy commitments and investments that just five years ago would have been unimaginable. This nascent transformation is marked by perceptible changes in awareness, attitudes, markets and technologies, making green growth and transition to a green economy more economically and politically feasible than ever before.

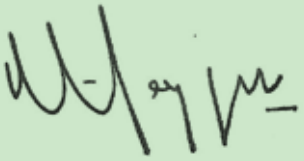
Green growth strategies can help economies and societies become more resilient as they work to meet demands for food production, transport, housing, energy and water. Strategies can help mitigate the impacts of adverse shocks by reducing the intensity of resource consumption and environmental impacts, while alleviating pressure on commodity prices. Green growth also offers competitive advantages to those countries that commit to policy innovations. The global market for green goods and services is vast and growing fast, offering countries the dual benefit of prosperity and job creation.

To take advantage of these opportunities, long-term solutions require policy initiatives to transform economies, building on already important initiatives in many countries. Economies must be recalibrated so that economic growth is directly aligned with sustainable development objectives. The need for new infrastructure investment in the region presents opportunities for planners and policymakers to design, build, and operate infrastructure on principles of sustainability, including accessibility and social inclusiveness.

Governments must play their part, enabling the private sector to seize emerging opportunities while also engaging the public in finding effective and equitable solutions that are adapted to the special circumstances and needs of each country and community. Governance approaches that emphasize inclusiveness and adaptability, as well as regional cooperation, are critical requirements for any transition.

Reflecting a common view that action is urgently needed, the United Nations Economic and Social Commission for Asia and the Pacific, the Asian Development Bank and the United Nations Environment Programme have joined forces to produce this report on *Green Growth, Resources and Resilience.* Each institution has its own mandates and the three find common ground in working together to help catalyze action for sustainable and inclusive economic growth—a future where all people have an opportunity for a better life.

Decision makers at the sixth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED), held in 2010 in Astana, Kazakhstan, have discussed the key findings and recommendations of a preview of this report. Looking beyond MCED, this report provides a wealth of information to facilitate the regional and global preparations for the United Nations Conference on Sustainable Development, to be held in Rio de Janeiro in 2012. This report will help all stakeholders take urgent action to chart our way to a more sustainable future.



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About the report

Background

This report—*Green Growth, Resources, and Resilience*—is the product of a combined effort by three institutions: the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the Asian Development Bank (ADB) and the United Nations Environment Programme (UNEP). It is the sixth in a series of reports published every five years since 1985 by ESCAP (formerly known as the State of the Environment in Asia and the Pacific series). It is also the third in ADB's *Asian Environment Outlook* series, funded by a Technical Assistance project – Preparation of the 2010 Asian Environment Outlook – for which financing was approved in May 2009 through the Technical Assistance Special Fund. It is also in line with UNEP's mandate to keep the state of the environment under review.

A Preview[1] of this report was distributed during the sixth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED 6), held in Astana, Kazakhstan, in September 2010. This full report comes at a key time as governments and other stakeholders prepare for the 2012 United Nations Conference on Sustainable Development (UNCSD) to secure renewed political commitment for sustainable development, assess progress to date and the remaining gaps in implementation of the outcomes of the major summits on sustainable development, and address new and emerging challenges, 20 years after the 1992 Earth Summit.

In 2005, the need to "shift the development orientation from a 'grow first, clean up later' approach to one of green growth," was a key message of MCED 5.[2] Then, the term "green growth" was relatively new to the international arena, but since then, green growth and related concepts have increasingly become an important part of the sustainable development agenda. This is underscored by the fact that one of the two themes of UNCSD is *a green economy in the context of sustainable development and poverty eradication*.

Organization

The report is organized into six chapters:

The first chapter describes an evolving policy landscape in which rising demand for resources, along with increasingly apparent impacts from climate change, are bringing together economic, social and environmental crises, providing new opportunities and giving rise to new governance challenges.

The second chapter provides a detailed examination of resource use and efficiency trends, showing the complex nature of resource risks posed by the scale and speed of the economic transition and resource-intensive patterns of growth.

The third chapter outlines key policy actions for bringing economic growth strategies in closer alignment with the objective of sustainable development.

The fourth chapter describes how new governance challenges can be addressed at a number of levels, from international and regional governance structures down to national and local levels.

The fifth chapter focuses on illustrative strategies to promote improved resilience, a concept that centers on the capacity of societies and economies to resist and adapt to shocks and, whenever possible, turn crisis into opportunity.

The concluding chapter highlights some of the important findings of the report and comments on the implications for the two themes of the United Nations Conference on Sustainable Development (Rio+20).

Acknowledgements

Members of the team that coordinated the preparation of the report and provided significant input into all chapters were: Masakazu Ichimura, Chief, and Hitomi Rankine, Environmental Affairs Officer of the Environment and Development Policy Section, Environment and Development Division, United Nations Economic and Social Commission for Asia and the Pacific (ESCAP); Daniele Ponzi, Lead Environment Specialist, and Jeffrey Bowyer, Environment Specialist (Consultant) of the Environment and Safeguards Division, Asian Development Bank (ADB); and Anna Stabrawa, Regional Coordinator for Early Warning and Assessment of the Regional Office for Asia and the Pacific, United Nations Environment Programme (UNEP). Dechen Tsering, Jinhua Zhang and Tunnie Srisakulchairak supported UNEP's contribution, while Peter King and Benoit Laplante acted as technical advisors on all chapters.

Several people provided significant contributions to specific aspects of the report, including: Heinz Schandl, Jim West and Karin Hosking on the theme of resource use and resource efficiency; Louis Lebel, Natalja Wehmer, Shaswat Saptkota, Aksel Sundstrom on inclusive and adaptive governance; Wanhua Yang, Hans van Rijn and Peter King on governance; Dan Millison, Lorenzo Santucci and Kelly Hayden on sustainable infrastructure; Ti Le Huu and Ermina Sokou on water; Jay Maclean on sustainable agriculture; Vincent Jugault and Marc Ruffet on green jobs; Charles Rodgers on adaptation to climate change; and Brian Carisma on the use of data. David Annandale also provided inputs on a number of topics.

The report was edited by Jay Maclean and Orestes Plascencia. The cover page and layout were prepared by Ruedee Arunkhajohnsak and Michael Cortes, and administrative and secretarial assistance was provided by Wipavee Kasemsawasdi, Rujira Khrueachotikul, Siriwat Theerawong, Sirkul Suvarnnate (ESCAP) and Charina Munda (ADB).

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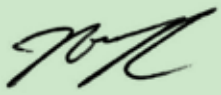

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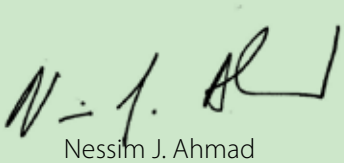

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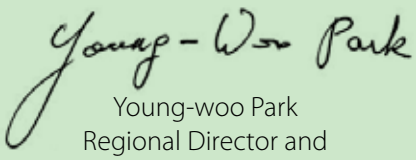

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* In East and North-East Asia: China; Japan; Republic of Korea; Mongolia; In South-East Asia: Indonesia; Malaysia; Myanmar; Philippines; Thailand; Viet Nam; In South and South-West Asia: Bangladesh; India; Iran, Islamic Republic of; Pakistan; Sri Lanka; Turkey; In North and Central Asia: Armenia; Azerbaijan; Georgia; Kazakhstan; Kyrgystan; Russian Federation; Tajikistan; Turkmenistan; Uzbekistan; In The Pacific: Australia; New Zealand; Fiji; Papau New Guinea

Notes

The symbol "$" stands for the United States dollar unless otherwise indicated.

The Asian and Pacific region, unless otherwise specified, refers to the group of ESCAP members and associate members which are considered to lie within the Asian and Pacific geographic region. ESCAP, ADB and UNEP have differing regional compositions.

Subregions used in this report are as defined by ESCAP, and their countries are, unless otherwise specified:

East and North-East Asia: China, Democratic People's Republic of Korea, Japan, Mongolia and the Republic of Korea.

North and Central Asia: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Russian Federation, Turkmenistan and Uzbekistan.

South-East Asia: Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste and Viet Nam.

South and South-West Asia: Afghanistan, Bangladesh, Bhutan, India, Islamic Republic of Iran, Maldives, Nepal, Pakistan, Sri Lanka and Turkey.

The Pacific: Australia, Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

Abbreviations and acronyms

ADB	–	Asian Development Bank
AECEN	–	Asian Environmental Compliance and Enforcement Network
ASEAN	–	Association of Southeast Asian Nations
BRT	–	bus rapid transit
CBD	–	Convention on Biological Diversity
CO_2	–	carbon dioxide
CSIRO	–	Commonwealth Scientific and Industrial Research Organisation
DMC	–	domestic material consumption
EJ	–	exajoule
EPRD	–	Environmental performance rating and public disclosure
ESCAP	–	Economic and Social Commission for Asia and the Pacific
FAO	–	Food and Agriculture Organization of the United Nations
FES	–	forest ecosystem services
FIT	–	feed-in-tariff
GDP	–	gross domestic product
GEF	–	Global Environment Facility
GHG	–	greenhouse gas
GJ	–	gigajoule
GMS	–	Greater Mekong Subregion
HDI	–	Human Development Index
IEA	–	International Energy Agency
IEG	–	international environmental governance
IFI	–	international financial institution
IFSD	–	institutional framework for sustainable development
ILO	–	International Labour Organization
IRRI	–	International Rice Research Institute
MCED	–	Ministerial Conference on Environment and Development in Asia and the Pacific
MDG	–	Millennium Development Goal
MEA	–	multilateral environmental agreement
MJ	–	megajoule
mtoe	–	million tons of oil equivalent
OECD	–	Organisation for Economic Co-operation and Development
PES	–	payments for ecosystem services
PPP	–	public-private partnership
REDD	–	reducing emissions from deforestation and forest degradation
REEO	–	Resource Efficiency: Economics and Outlook for Asia and the Pacific
Rio+20	–	2012 United Nations Conference on Sustainable Development
TEEB	–	The Economics of Ecosystems and Biodiversity
UNCCD	–	United Nations Convention to Combat Desertification
UNEP	–	United Nations Environment Programme
UNFCCC	–	United Nations Framework Convention on Climate Change
WEF	–	World Economic Forum
WTO	–	World Trade Organization

EXECUTIVE SUMMARY

In the last two decades, the growth rates of Asian and Pacific economies were among the highest in the world. The strong economic growth has lifted more than half a billion of its people out of poverty and has raised living standards. At the same time, socio-economic progress was achieved at great environmental cost due to unsustainable and often inequitable economic growth patterns. Rapid urbanization and industrialization involving intensive use of resources has accelerated the degradation of natural capital and the production of waste and emissions. Resource depletion and pollution resulting from such activities as energy use and land-use change, have become global issues, evidenced by increased worldwide attention to climate change and biodiversity loss.

The concept of green growth has emerged amid concerns over increasingly evident resource constraints and growing economic and environmental risk and uncertainty that threaten the continued stability and prosperity of the region. This report has been produced to support policymakers and stakeholders in this changing development context. It provides a closer look at resource use trends and at green growth strategies in response to the mounting challenges to sustainable development and in support of a transition towards green economies in the region.

Converging challenges and a shifting socio-economic outlook

Policymakers are operating in a rapidly changing economic reality, one in which economic strategies that rely on an unlimited supply of free or cheap resources will no longer be possible. Intensive resource use, rising energy costs, limited resource endowments, climate change and declines in the ability of ecosystems to provide critical ecosystem services, are all working together to expand environmental, economic and social vulnerabilities and uncertainties.

The triple food, fuel and financial crisis that came to a head in late 2008 resulted in a global recession, unemployment, hunger and social conflict. In 2008, there were still some 947 million people living in poverty in the Asian and Pacific region. By 2009-2010, as many as 21 million additional people in the region may have moved below the poverty line as a result of the 2008 crisis. Although the region as a whole is still on track for achieving the first Millennium Development Goal – halving, between 1990 and 2015, the proportion of people below the poverty line – hard-won gains in reducing poverty and improving people's lives are now in danger of being reversed in some countries.

One of the major challenges facing the region will be overcoming resource constraints, including energy, minerals, water and land, as people in the region strive to achieve higher living standards. Global supplies of non-renewable resources cannot readily accommodate the rapid changes in demand that are currently being witnessed in the region. Meanwhile, renewable resources, such as forests and groundwater resources, are also under threat.

Perhaps most significantly, there are growing concerns about both the adequacy and stability of food supply, particularly in light of the continuing food price rises. Food supply is being affected by a number of factors, including low crop yields, rising input costs, competing demands for freshwater, loss of farm land for housing and industry and neglect of investment. Climate-related extreme weather events are compounding these challenges. In addition, the competition for land and changing market forces mean that production of non-food crops is expanding faster than production of food crops, including in South Asia and East Asia, where hunger and undernourishment challenges persist or are growing. Also, in some countries, undernourishment rates are much higher than expected given overall average calorific intakes, while the amount of food available for human consumption is dramatically reduced by food waste. In response to these trends, there has been a perceptible increase in emphasis on self-sufficiency in food production, and wealthier countries with limited agricultural land have sought to secure access to land for agricultural production in other countries.

Seasonal shortfalls in the availability of water are another present and growing crisis in many parts of Asia. While the region has the world's largest share of renewable freshwater resources, on a per capita basis, it has the lowest availability of water. Complex, evolving, and interrelated water security challenges include competing demands for water, including for agriculture, energy, industry, and domestic use; declining water quality; and vulnerability to climate and ecosystem changes. Seasonal water shortages have become more severe in certain parts of the region, posing a major constraint to economic development and affecting the region's food and energy production, its ecological needs, and the health and livelihoods of its populations. Better understanding of the concept of water insecurity, along with ways to asses this, are needed.

Meanwhile, as energy demands mount, countries in the region will become increasingly vulnerable to price shocks, especially those that import energy and have high energy intensity (i.e., energy consumed per unit of gross domestic product). Vulnerabilities linked to energy import dependence, aggravated by the volatility of energy prices, will continue to have far-reaching implications for the financial ability of countries to meet their energy demands. A number of countries, especially those in South Asia, face these challenges as they also attempt to greatly increase energy access for their populations.

Ecosystem goods and services provided by natural capital are also in decline due to poor natural resource management decisions, growing human populations and increased per capita consumption. As of 2008, the Asian and Pacific region had the highest number of threatened species, while net gains in forest cover for the region overall hide continuing conversion of primary forested lands, which has accelerated in several countries. These losses are significant given that the region's biodiversity and natural resources provide sustenance for millions of people while providing valuable goods and services that help drive economies—from seafood, agricultural products, and timber to waste assimilation, nutrient recycling, aquifer recharge, and climate change regulation.

Finally, rising material and energy use has resulted in growing emissions, pollution and waste levels. Although the majority of the historical build-up of atmospheric greenhouse gas (GHG) emissions is the result of emissions from developed countries, Asian developing countries account for the fastest growing source of new emissions. At the same time, the consequences of climate change are increasingly acknowledged to pose a real threat to the region's expanded economic prosperity and improved livelihoods. Poor communities in both rural and urban settings are the most vulnerable to the negative impacts, with those in small island developing states facing perhaps the most immediate challenges.

Green shoots – new opportunities and challenges

While sustained economic growth remains necessary, leaders around the region increasingly recognize that to reduce poverty and increase resilience, a greater focus is needed on achieving a better *quality* of growth. At the national level, a number of Asia and Pacific countries have pursued and invested in green strategies and policy reform, most notably China, Japan, and the Republic of Korea. Many other countries have made major policy statements supporting green growth, including Cambodia, Fiji, Kazakhstan, Maldives and Mongolia. Several countries have established strategies and policies for low-carbon development, including voluntary targets for reducing GHG emissions or carbon intensities. The Asian and Pacific region is also leading the globe in commitments to green investments, including low-carbon power generation (renewable energy and carbon capture and storage), energy and fuel efficiency (buildings, public transport and electricity grids), and water supply and waste management.

Recent policy initiatives hint at the potential for fundamental economic transformations needed to secure a sustainable future. There are tremendous opportunities presented by fledging markets, relatively low levels of per capita consumption, and unmet infrastructure needs. "No regret" economic strategies – those that generate benefits under a wide range of potential conditions – can be deployed in developing countries, reflecting a new economic reality. Such strategies can reduce resource risks and can be adapted to each country's needs and circumstances.

New challenges for governance are an important aspect of the changing policy landscape. Governance approaches and institutions are

needed that integrate multiple perspectives across different sectors, given that economic issues still often take precedence over social and environmental concerns. Furthermore, in many countries, governments must increasingly account for the fact that the general public has heightened expectations regarding participation, as well as stronger capacities to self-organize and increased access to information.

Resource use trends – learning from the past and looking to the future

Between 1995 and 2005, Asian and Pacific consumption of four main types of materials – biomass, fossil fuels, metal ores/industrial minerals and construction minerals – grew by 50 per cent, from 23.6 billion tons to around 35.3 billion tons. Since the mid-1990s, the region has accounted for well over half of global material use, overtaking all other regions combined.

As of 2005, the Asian and Pacific region required three times the input of resources as the rest of the world to produce one unit of GDP. Ominously, material intensity in the region as a whole increased from 2000 to (at least) 2005, reversing previous trends. The main reason for this reversal is that economic activity in the region, as well as in the world, is shifting away from relatively more efficient centres of production, such as Japan, to relatively more resource-intensive centres of production, such as China. The enormity of this shift has been enough to affect regional and global efficiency trends, even as most economies (including China itself) are becoming more efficient. If these trends continue, extractive pressures on the environment will increase even faster than the rapid rates of economic growth.

Many countries in the region are also experiencing dramatic changes in material use profiles, away from agricultural systems and biomass and toward urban/industrial systems and mineral materials. Large amounts of sand, gravel and other bulk construction materials are being used to build rapidly-expanding cities and transport infrastructure and for manufacturing. This shift in material use is also influenced by a growing middle class that can afford commodities that characterize a modern lifestyle. Perhaps most significant is the higher per capita consumption of transport fuels as a result of rapid motorization. Also, the tendency for societies to change to diets richer in animal protein as they become more affluent is increasing competition for biomass production from arable land.

For most subregions, dependence on external resources is increasing. Many developing economies in Asia and the Pacific are now net importers of raw materials, especially fossil fuels and metals. East and North-East Asia, an economically diverse and dynamic but resource-constrained subregion, is importing increasing quantities of resources per capita to satisfy its growing rate of material consumption. South-East Asia and South and South-West Asia, subregions with high poverty rates and low per capita access to resources, have physical trade balances that are also increasing – signaling increasing reliance on imports. The growing resource demands in the region will be reflected in rising prices for fossil fuels, ores and food, adding pressure to national and household budgets.

A continuation of these trends will further increase the exposure to risks associated with relying on external suppliers, especially for those countries with low resource endowments. Under a business-as-usual scenario, the region will continue to witness rapid growth in material and energy use, along with carbon dioxide emissions. Based on modelling conducted for the report of the United Nations Environment Programme (UNEP), *Resource Efficiency: Economics and Outlook for Asia and the Pacific* (REEO), if current trends continue, the region (as defined by UNEP) will consume at least 80 billion tons of materials and 700 exajoules of energy per year; CO_2 emissions are likely to more than triple by 2050.

Even making use of all technological potential within existing systems will not be sufficient to ensure long-term reductions in the negative impacts on resources and the environment. Efficiency gains would eventually be unable to keep pace with growing populations and per capita consumption rates. Furthermore, equitable access to resources is an increasingly growing concern.

In response to this changing context, it will be vital for regional economies to improve resource efficiency while maintaining gains in labour productivity to enable further growth, but at much lower environmental costs. In the medium- and long-term, environmentally and economically sustainable growth can only happen through a second industrial revolution characterized by

systems innovation, high resource use efficiency, and a greatly reduced reliance on hydrocarbons. Significant structural changes will be needed in patterns of consumption and production, affecting everything from how people are housed and move around to how water, energy and food are produced. This will require substantial changes in policies, economic behaviour and societal aspirations to develop in a way that requires less materials and energy and allows for higher flexibility and lower risks in the face of global environmental change and resource scarcity.

Green growth strategies – recalibrating economies for greater alignment with sustainable development objectives

Green growth is, in general terms, economic progress that fosters environmentally sustainable, low-carbon and socially inclusive development. By "recalibrating" the economy to synergise economic growth and environmental protection, "green growth" strategies work to bring economic growth trajectories in better alignment with sustainable development objectives. Such strategies can help build a "green economy," characterized by substantially increased investments in economic activities that build on and enhance the earth's natural capital, while reducing ecological scarcities and environmental risks – activities such as renewable energy, low-carbon transport, energy- and water-efficient buildings, sustainable agriculture and forest management and sustainable fisheries.

Greening of growth requires integrated strategies that support systemic change in integrated, complementary and mutually reinforcing ways. A key concept in approaching green growth is recognition that economic, social and environmental systems are actually complementary, not in conflict. For those focusing on the environment, green growth is a way to reduce environmental stress; for economists, it can offer increased profits and competitiveness; and for social scientists, it can contribute to ensuring that basic needs are met.

A supportive economic incentives framework lies at the heart of successful green growth initiatives. While the market will play a key role in determining economic outcomes, market solutions will not emerge automatically. Green investments in pursuit of green growth will deliver large long-term benefits, but they sometimes do so only after significant upfront costs are incurred over a period of many years. Addressing this "time gap" between short-term costs and long-term benefits of green investments will require collaborative action between governments and the private sector to overcome the present financial barriers and risks that restrict capital flows into green sectors, thereby leading to increased investment.

For developing countries in particular, enhancing the level of green investments will also require reducing the "price gap" between market prices and the economic value of ecosystem goods and services, thereby improving the economic viability of a green economy and reducing environmental pressures on a large scale. Without efforts to correct market failures by internalizing the costs of negative social and environmental externalities, any momentum achieved by green stimulus investments and new financing will be quickly lost, as gains in environmental protection and resource efficiency will be countered by increases in absolute levels of resource use, pollution and emissions, as economies, population and per capita consumption grow.

To help provide this momentum, eco-tax reform offers a key cross-cutting, integrative policy tool that can help to secure a "double-dividend" for both the economy and the environment by emphasizing a shift from taxing the "goods" (for example labour) to taxing the "bads" (resource use and pollution). Policymakers can reduce fundamental economic-environment-social development trade-offs that make conventional growth strategies unsustainable by boosting tax and other economic incentives to improve resource productivity. Tax systems are most effectively modified within broader budget reform efforts (including subsidy reform and the use of a wide range of incentives, fees and surcharges) and a flexible system of budget redistribution.

Infrastructure investments should be guided by the principles of sustainability, accessibility, and social inclusiveness. The ability of economies to reduce the quantity of resources used by the built environment is a

major green growth opportunity. About two thirds of the $8 trillion needed for infrastructure investment in Asia and the Pacific between 2010 and 2020 will be in the form of new infrastructure, which creates tremendous opportunities to design, finance and manage more sustainable infrastructure. The development of conventional infrastructure locks regional economies into unsustainable patterns of resource use for many decades, reducing the prospects for sustainable outcomes. It will be vital for planners and policymakers to take advantage of this crucial window of opportunity to change resource-use patterns.

Building sustainability into infrastructure – including housing, transportation networks, energy and water supplies – involves replacing and upgrading existing infrastructure with more eco-efficient systems and building around the needs of people at a scale that reduces operating costs and increases accessibility and social inclusion. Through integrated approaches, sustainable infrastructure can also help provide multiple environmental, economic and social benefits. For example, investments in sustainable transport and urban planning help reduce GHG emissions and air and water pollution, while improving urban mobility, access to markets, public health and the investment climate.

Sustainable infrastructure need not cost more than conventional infrastructure over the long term if investments are sequenced and financed appropriately, balancing up-front capital costs with lifetime operating costs. Investing in efficiency normally pays for itself in resource savings and can offset the need for some large-scale centralized infrastructure. However, the realization of huge potential efficiency gains remains hampered by a lack of instruments to "monetize" the benefits of conservation and efficiency and to reward sustainable consumption. Innovative financing models are also needed, with technological innovation given adequate policy support to achieve sufficient market penetration.

"Natural infrastructure" provides valuable but undervalued economic inputs. A green economy recognizes and capitalizes on this value and provides incentives for maintaining its function. Natural capital investments will, over time, help to secure critical ecosystem services (such as water regulation and flood control), achieve cost savings on infrastructure development, improve human and environmental security and can strengthen climate adaptation efforts through ecosystem-based adaptation approaches. Sustainable management of natural capital also enhances the potential for ecosystem services for economic transformation—for example where eco-tourism potential is developed as an economic development strategy. Investments should be targeted at key ecosystem services that hold particular value for their economies and societies.

However, such investments are not happening at the necessary scale because the economic value of natural capital is rarely captured in decision-making processes, due to limited indicators, accounting systems and prices in the market. To address this problem, improved understanding and quantitative measurement of biodiversity and ecosystem values are needed to support improved governance and policy on natural resource management and to make the case for investments in ecological infrastructure.

There is an opportunity to increase financial incentives for sustainable natural resources management through payments and markets for key ecosystem services, such as through the United Nations Framework Convention on Climate Change (UNFCCC) approach on Reducing Emissions from Deforestation and Forest Degradation and payments for ecosystem services schemes. In all of these efforts, care must be taken to ensure that livelihoods and community development outcomes are enhanced for local and indigenous peoples.

Sustainable agriculture is a critical aspect of maintaining and building natural capital. To respond to growing challenges in this sector, governments will need to move beyond simply increasing productivity to developing strategies that ensure optimal and eco-efficient use of agricultural lands, water and other agricultural inputs, while also ensuring equitable social and economic benefits. There is a need to redouble investments in research and development to address the gaps in the knowledge needed to deal with changes in the agricultural sector, including efforts to harness the traditional knowledge of farmers and preserve genetic diversity as a basis for competitiveness and resilience. Experiences with supporting women farmers in the region have shown the importance of approaches that take gender considerations into account.

An enabling environment: policy integration, governance, and poverty reduction

A long-term plan to enable systemic change requires an integrated policy framework. Greening of growth requires integrated strategies that support systemic change in integrated, complementary and mutually reinforcing ways. The complexity of challenges faced means that a clear vision, targets and monitoring approach are required. Also needed are targets and indicators that give policy-relevant information on the extent to which the economy is "growing green."

Cross-cutting and integrated policy tools, such as ecological tax reform, can harmonise actions in and across specific policy arenas, including sustainable infrastructure development, greening of markets and businesses, sustainable consumption and investment in natural capital.

Other approaches to developing integrated policy frameworks include focusing investments in economic sectors that both create higher quality jobs and support the reduction of energy and resource use (an example is provided by the renewable energy sector). In an integrated policy framework, demand-side and supply-side policy interventions support each other. The concept of ecosystem services can be used to integrate strategies that secure investments in natural capital with those that enhance long-term economic viability and competitiveness and poverty reduction.

A transition to a green economy requires governance that is effective, fair and inclusive. The shortcomings of environmental and sustainable development governance at all levels, from global to local, are being addressed through a range of processes and approaches. Examples of effective governance exist in the region, but may be highly context specific. In terms of transferability and replicability, there is a need for further rigorous analysis, as well as coordinated action involving all stakeholders, to tailor governance solutions to appropriate circumstances and scale.

Managing a transition to a green economy as the basis for sustainable development requires governance approaches that are inclusive to ensure that the perspectives, creativity, knowledge and experience of all stakeholders, including the private sector, can help better define both problems and solutions. The needs, interests and capabilities of disadvantaged and vulnerable groups should be fully accounted for in the public decision-making process and in formulating suitable responses. Such inclusiveness can help ensure that resources are used and risks shared in a more equitable manner. An effective transition toward long-term sustainability and greater resilience also requires governance approaches that are adaptive, involving specific mechanisms to learn from policy experiences and adapt them as needed (see below).

The consideration of the institutional framework for sustainable development (IFSD) as one of the two major themes of United Nations Conference on Sustainable Development presents an unprecedented opportunity to address the shortcomings of governance for sustainable development, including international environmental governance. The outcome of discussions on IFSD will play an important role in shaping future governance solutions.

Specific measures will be needed to strengthen the synergies between green growth and poverty reduction strategies. Policies for greening economic growth are not a substitute for sound social policies and thus cannot alone address the root causes of persistent poverty. Rather, green growth measures must be complemented by actions to ensure a "just transition" for workers and enterprises and to ensure that regressive impacts are minimized and mitigated. These actions should be based on dialogue between government, industry and trade unions. Education for sustainable development, both formal and non-formal, also remains a basic condition for progress on sustainable development and for building human capital. School curricula and skills training need to be rapidly re-evaluated, updated and scaled up to meet the emerging demands for skilled labour in sectors that are likely to be negatively affected and for the creation of new green jobs.

Strengthening resilience

The Asian and Pacific region has made encouraging first steps towards green growth as one path to sustainable development. With further commitment, deepening insight into policy solutions and with the right investments,

the region could lead the globe toward a brighter, more sustainable, future. Securing such a future also depends on achieving greater resilience—the capacity to survive, adapt and grow in the face of unforeseen, often sudden, changes.

A shift to greener growth can mitigate the impacts of adverse shocks by reducing the intensity of resource consumption, alleviating pressure on commodity prices and simultaneously fostering economic, social and environmental resilience. Resilience in the context of green growth comprises various actions – such as economic diversification, energy security, ecosystem preservation, and sustainable production and consumption. Such measures should be accompanied by efforts to deal with incomplete information and uncertainty.

Approaches that enhance the capacity of communities and economies to resist initial shocks and to self-organize and adapt to changing conditions will be increasingly important. Countries can explore more adaptive governance approaches that allow knowledge and flexibility to be integrated into the institutions that sustain human well-being in the face of complexity and change and promote resilience and transformation. Such "adaptive capacity" is the ability of a system not only to recover from shocks, but also to reform system functions and feedbacks without losing its ability to carry out the task for which it has been designed.

The combined efforts of a wide range of stakeholders through productive partnerships will also be essential to enable green growth. Such efforts can apply to, for example, adaptive co-management of natural resources, which seek to integrate conservation objectives with sustainable resource use; engagement of multiple stakeholders in the pursuit of sustainable cities, including upgrading slum communities; and managing climate risks in agriculture by facilitating close engagement between researchers and farmers, who have substantial experience with managing risks arising from natural climate variability.

To ensure greater resilience, domestic policies should also encourage diversification in key sectors, such as industry, agriculture and energy. Diversifying and decentralizing energy systems, for example, can help countries move away from their heavy dependence on fossil fuels, which makes regional economies susceptible to price shocks and raises energy security concerns. While conventional, centralized infrastructure is still necessary, modular and decentralized services may be more appropriate in some cases, especially when funding constraints exist.

To address climate change adaptation, countries should take a "no regrets" approach. Such an approach to adaptation involves measures that represent sound development practice as part of a broader effort to achieve inclusive and environmentally sustainable growth. This approach is in contrast with current practice in many countries – waiting for more advanced forecasting systems before taking action. Approaches must span a continuum of responses, from those that are entirely justified by specific impacts on specific locations to those that represent sound development practice and confer benefits under a wide range of potential climatic conditions, even in the absence of proven climate change. This "no-regrets" approach can deliver outcomes appropriate to a wide range of opportunities, function effectively in a wide range of conditions and provide high levels of security and confidence. Guiding principles should include keeping the focus on development and poverty reduction, using sound science and forecasting, incorporating ecosystem-based approaches, and sharing risks through insurance schemes.

Final thoughts

The convergent challenges faced by the Asian and Pacific region threaten to seriously undermine achievement of the elusive goal of sustainable development. An increasingly globalized economy, growing demand for resources of all kinds, unmet basic needs and climate change mean that society, the environment and the economy are more vulnerable than ever.

This report shows that the choices that Asian and Pacific countries make in relation to economic strategies over the next few decades are critically important for the future of the region's people and for the planet as a whole. Fundamental changes in the way that economies grow will be needed to address the risks and challenges of reducing poverty on a limited resource base - technological innovation and improvements in resource efficiency alone will not be sufficient.

Governance approaches that support effective transition management towards green growth and sustainable development will be as important

as setting targets and formulating strategies. A focus on improving the quality of growth, encompassing an expanded range of economic, social and environmental considerations, must become as important as, or even more important than, expanding gross domestic product.

How these strategic priorities are approached by policymakers will differ, depending on the situation in each country. Levels of development, resource endowments, demands placed on those endowments, current patterns of resource use, governance structures, and vulnerability to environmental change, in particular climate change, will define the targets and implementation of specific strategies.

There have been persistent calls for green growth strategies to play a significant role in poverty reduction. This potential exists, but must be strengthened through specific policies, including in the social sector. Green growth strategies, on their own, cannot address the root causes of poverty. An exploration of persistent poverty, inequality and its links to resource use need further attention in policy research and analysis.

There is also growing consensus on the urgent need for action, and governments must play a key role in leading the response. There is also good potential for engaging the private sector as an active partner for improving environmental performance. Competitive forces are driving improvements in environmental performance of key industries, such as tourism, automobiles and electronics, and governments can help facilitate these forces.

Strengthened regional and international cooperation will also be needed, including specific support for developing countries. International cooperation will be needed to support specific measures to close development gaps, deal with interlinked challenges, and build a future in which the focus on securing better outcomes for all people provides impetus for a better quality of economic growth.

CHAPTER 1: A CHANGING LANDSCAPE, EVOLVING POLICY CHALLENGES AND OPPORTUNITIES

The strong economic growth experienced in Asia and the Pacific in the last two decades has immensely benefited the region and lifted more than half a billion of its people out of poverty. At the same time, economies and societies around the globe, including those of the region, are facing a series of convergent challenges: mounting threats to food, water and energy security, continuing economic uncertainty and projected worsening of climate change impacts.

This changing landscape highlights the need for the region to synergize improvements in resource-use efficiency, environmental protection and economic growth, while ensuring equitable outcomes for its people. Achieving economic, social and environmental resilience will require specific investments as well as policy and governance responses.

This chapter describes the changing regional outlook, selected actions by countries of the region since 2005 and emerging policy challenges.

A changing regional outlook—converging challenges

For the last two decades, the growth rates of Asian and Pacific economies have been among the highest in the world, and the positive impacts of this economic expansion have been significant. Between 1990 and 2005, the region's population living in extreme poverty—on less than $1.25 per day—fell from 1.5 billion to 979 million.[1] Expectations were raised that many developing countries of the region would achieve Millennium Development Goal (MDG) 1 of halving the number of people in poverty by 2015.

At the same time, there were warnings that this socio-economic progress had been achieved at great environmental cost due to unsustainable and often inequitable economic growth patterns.[2] In 2005, the regional assessment for the fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED) stressed that the ongoing shift of a large part of the world's industrial activity to the Asian and Pacific region, coupled with rapid urbanization and industrialization involving intensive use of resources, had exerted considerable environmental pressure.

Although some aspects of the region's environmental performance had improved (for example, better urban air quality in some cities and slowed rates of forest loss), unsustainable economic growth trends, frequent and severe natural disasters and climate change threatened the prospects for continued growth and an acceptable and healthy quality of life.[3]

The triple food, fuel and financial crisis that came to a head in late 2008 resulted in a global recession, unemployment, hunger and social conflict. In 2008, there were still some 947 million people living in poverty in the Asian and Pacific region.[4] By 2009-2010, as many as 21 million more people in the region may have moved below the poverty line.[5]

Nevertheless, China, India and other countries in the region continued their rapid economic growth trajectories, and the developing Asian and Pacific economies were projected to grow by 7.3 per cent in 2011, in contrast to the slower and more tentative recovery of the major industrial

economies.[6] However, the region still faces increasingly convergent challenges—insecurity about food, water and energy supplies; persistent economic uncertainty; and climate change impacts (Box 1.1). These challenges reflect economic growth strategies that have long undervalued natural resources and emphasized resource-intensive investments.

Meanwhile, despite its significant achievements, the region is still home to two thirds of the world's poor[7] and lags far behind the developed economies in terms of per capita income. Inflationary pressures that have influenced political change in several countries also threaten to entrench poverty and slow economic recovery.

While in 2010, the region was assessed as still being on track for achieving MDG-1,[8] hard-won gains in reducing poverty and improving people's lives are now in danger of being reversed in some countries. Recent investigations of the impact of a projected worst case scenario of doubled food inflation and a $130/barrel oil price showed that

Box 1.1: The 2008 crisis – a precursor?

The 2008 triple food, fuel and financial crisis was an indicator of what the future may hold. Growing demand for key commodities, together with climate change, speculative investments and other factors, dramatically increased prices until 2008, resulting in critical impacts on global, national and local economies and people.

Higher food prices in Asia and the Pacific had already increased the number of undernourished people from 542 million in 2003–2005 to 583 million in 2007,[a] but energy prices proved a critical pressure point. Oil prices hit an all-time high of $145/barrel in July 2008, and the prices of food, metals, minerals and other commodities rose together. As the prices of industrial inputs, construction materials and food increased (and other factors in the financial world weighed in), the global economy contracted dramatically and suddenly, and jobs and livelihoods were lost. The global recession interrupted the trend towards rising commodity, food and energy prices, but that trend has now resumed.

The World Bank reported that its food price index rose by 15 per cent between October 2010 and January 2011 alone—29 per cent above its level a year earlier and only 3 per cent below its June 2008 peak. In Asia, domestic prices of rice in early 2011 reached record levels in Bangladesh, China and Indonesia among other countries.[b] Such increases in food prices create macro vulnerabilities, particularly for countries with a high share of food imports and limited budget, as well as increases in poverty.

In the long term, upward pressures on food and agricultural commodity prices are expected to continue to grow as the costs of agricultural inputs (labour, energy, land and other environmental inputs) increase and as the demand for food and commodities continues to outpace increases in supply. The Food and Agriculture Organization of the United Nations (FAO) Food Price Index indicates that both real and nominal food prices more than doubled between 1990 and 2011,[c] while an Oxfam report projects that food prices will increase by some 120 to 180 per cent by 2030 without climate change, and that climate change will double this increase[d]

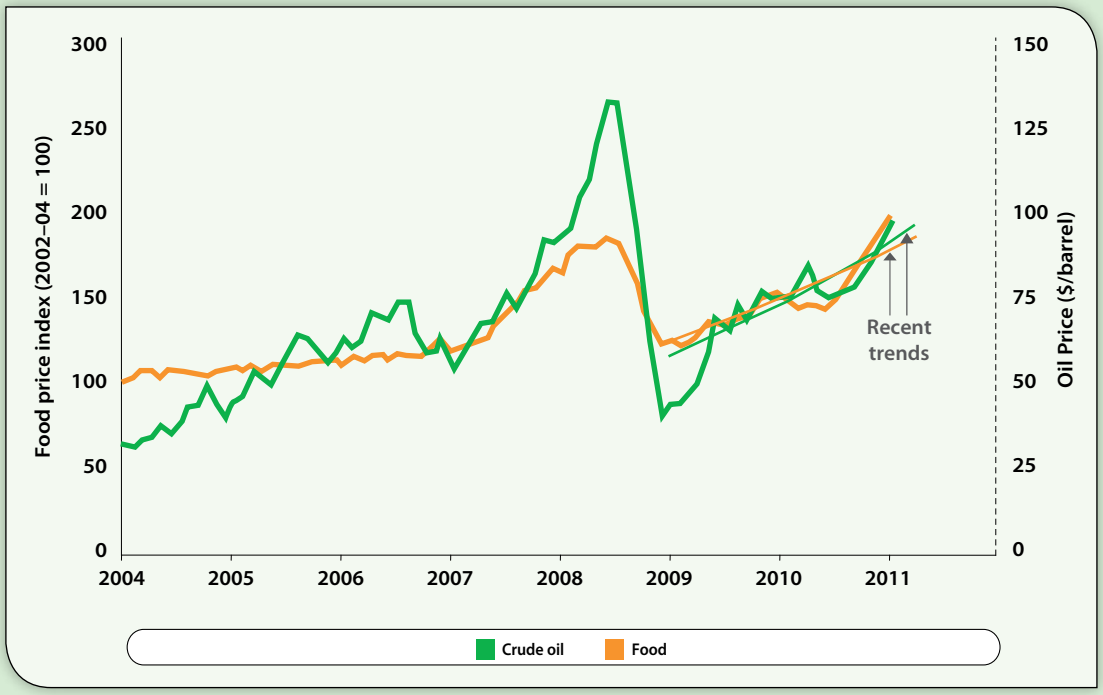
The perceptions of future resource scarcity have played a role in bringing economic, resource and environmental challenges together. Investments in closely integrated food, fuel and financial markets have increased the volatility of energy and commodity prices. As in the past, episodes of soaring prices will adversely affect the poor and the vulnerable.[e] Simulation results suggest that if a 30 per cent increase in global food prices continues through 2011, gross domestic product (GDP) growth for some food-importing countries in the region could be lowered by up to 0.6 percentage points and more than twice that if a 30 per cent increase in world oil prices also prevails. Even a 10 per cent rise in domestic food prices in developing Asia could push an additional 64.4 million into poverty.[f]

As climate-related extreme events become more frequent and severe, so will the impacts of these events on people and economies. In early August 2010, the Russian Federation experienced the highest temperatures on record and extensive wildfires, with massive impacts on grain production. At the same time, Pakistan experienced the worst floods in living memory, affecting more than 20 million people. The resulting shortfalls in grain production had an almost immediate impact on food prices. While the floods in Australia in early 2011 had the lowest death toll of the most recent disasters, the scale and reach of the economic impact across multiple economic sectors around the globe illustrate the vulnerability of

continued on next page.

resource supplies to climate-related disasters. The wheat and cotton lost in the Queensland floods are likely to have deepened global wheat and cotton shortages and increased global prices.[9]

FAO Food Price Index and Brent crude oil price, January 2004 to December 2010



Source: Economic and Social Commission for Asia and the Pacific (ESCAP), based on data from the Food and Agriculture Organization of the United Nations (FAO), *World Food Situation*, accessed from www.fao.org/worldfoodsituation/FoodPrices/Index/en and United States Energy Information Administration, accessed from http://tonto.eia.doe.gov/dnav/pet/hist/rbrteM.htm on 12 May 2011.

[a] Food and Agriculture Organization of the United Nations (FAO), "Hunger on the rise–soaring food prices and 75 million people to global hunger rolls", Briefing Paper, 17 September 2008, cited in Economic and Social Commission for Asia and the Pacific, *Economic and social survey of Asia and the Pacific 2009: addressing triple threats to development* (ST/ESCAP/2522) (Bangkok, 2009).

[b] Food and Agriculture Organization of the United Nations (FAO), *Global food price monitor*, accessed from www.fao.org/giews/english/gfpm/gfpm_02_2011.pdf. on 8 February 2011.

[c] Food and Agriculture Organization of the United Nations (FAO), *Food Price Index*, accessed from www.fao.org/worldfoodsituation/foodpricesindex/en. on 7 February 2011.

[d] R. Bailey, *Growing a better future: Food justice in a resource-constrained world* (London, Oxfam, 2011).

[e] Economic and Social Commission for Asia and the Pacific, *Economic and social survey of Asia and the Pacific 2009: addressing triple threats to development* (Bangkok, 2009).

[f] Asian Development Bank, *Global food price inflation and developing Asia* (Manila, 2011).

[g] IBISWorld, "*Queensland floods: The economic impact*", Special Report, January 2011, accessed from http://www.ibisworld.com.au/common/pdf/QLD%20floods%20special%20report.pdf on 2 February 2011.

the achievement of the MDG for poverty could be postponed by up to five years in some developing countries in the region.[9] The Economic and Social Commission for Asia and the Pacific (ESCAP) projects that rising food and oil prices could lead to an additional 42 million people in poverty in 2011.[10]

The inability of wage increases to keep pace with productivity increases and the persistence of jobless growth are also growing concerns in major economies, including in the Asian and Pacific region.[11] While shifts from labour-intensive to capital-intensive economic structures have supported economic growth, they have also reduced the capacity of some economies to provide rapid employment growth and expanded the inputs of energy and resources that have contributed to the growing environmental pressures.

Environmental change is an important source of uncertainty and risk. Recent findings indicate that humanity may have already transgressed three planetary "boundaries" or tipping points: for climate change, rate of biodiversity loss and changes to the global nitrogen cycle.[12] The tenth Conference of Parties to the Convention

on Biological Diversity, held in November 2010, concluded that the ongoing historically high rate of species extinction was of anthropogenic origin. Human activities now convert more nitrogen dioxide from the atmosphere into reactive forms than all of the Earth's terrestrial processes combined. The addition of various forms of reactive nitrogen to the environment erodes the resilience of several important ecosystems. In addition to biodiversity loss, nitrogen conversion and climate change, other processes under way that could trigger abrupt environmental change to continental- or planetary-scale environmental systems include ocean acidification, atmospheric aerosol loading, excess freshwater use, land-use change and chemical pollution.[13]

Given all of these factors, there is widespread recognition that gains achieved in recent decades are at risk. Without appropriate investments and policy interventions, pursuing economic growth as well as achieving an environmentally and socially sustainable future will become increasingly incompatible. As the 2011 World Economic Forum (WEF) pointed out,

> "The world is in no position to face major, new shocks. The financial crisis has reduced global economic resilience, while increasing geopolitical tension and heightened social concerns suggest that both governments and societies are less able than ever to cope with global challenges. Yet, we face ever-greater concerns regarding global risks, the prospect of rapid contagion through increasingly connected systems, and the threat of disastrous impacts."[14]

The WEF report notes the water-food-energy nexus as being one of the three important clusters of risks that have recently emerged and points to resource security issues (causing extreme volatility and sustained increases over the long run in energy and commodity prices) as being one of the five "risks to watch." The risk of global governance failure is also identified as being one of two especially significant risks.

Looking into the near future, demand for resources will be determined by the scale of unmet needs and human development. In this regard, the scope of the resource challenges facing the region looks daunting. In India, the number of households that can afford discretionary spending will grow from the present 8 million to an estimated 94 million by 2025;[15] and in China, the middle class is expected to grow from an estimated 87 million consumers in 2005 to 317 million by 2015.[16]

In addition, the region's low per capita supply of natural resources indicates that many countries will import an increasing amount of resources, leaving economies vulnerable to rising commodity prices. Those economies that are resource intensive—that is, using high amounts of natural resources per unit of economic activity—will be especially susceptible to inflationary impacts as commodity prices increase.

Security in a changing economic reality

The increasingly evident constraints in the supply of natural resources, the implications of climate change and the impacts of both on the global and regional outlook mean that economic growth strategies based on (i) an unlimited supply of cheap (or free) natural resources, (ii) resource-intensive mass consumption, and (iii) energy sources high in carbon content, are not economically, socially or environmentally sustainable. The vulnerabilities of an interconnected world have been exposed and risks have multiplied.

In response, economic development strategies must change to recognize that "the global economy is now so large that society can no longer safely pretend it operates within a limitless ecosystem."[17] If the region continues to aim for rapid economic growth, it will need to do so on a path that is less resource intensive, more protective of its environment and ecosystems, and more resilient to future economic, social and environmental challenges.[18] Difficult choices are looming at the nexus of the food, water and energy sectors, as water demand from the agriculture and energy sectors grows in the face of declining water resources in some areas.

Due to the demands on natural resources, economic strategies are needed for using resources more efficiently as well as meeting the needs of people more equitably. Economies of the region, for example, China, Japan and the Russian Federation, identify the efficient utilization of energy and other resources as important goals. Outside the region, the European

Commission notes that the critical dependence of the European Union on certain raw materials underlines the pressing need to shift towards a more resource-efficient economy and sustainable development.[19] Security of access to energy, resources, water and food has now become a key concern.

Energy security

As population, urbanization and income levels increase, the Asian and Pacific region is facing a major energy challenge. Energy access, affordability and quality continue to be important issues in developing Asian countries. The region remains home to a large number of people without access to modern forms of energy. Primary energy demand in the region is projected to increase from 4,025.3 million tons of oil equivalent (mtoe) in 2005 to 7,215.2 mtoe in 2030, growing at an annual rate of 2.4 per cent. Supplying this energy demand is expected to necessitate capital investments ranging between $7.0 trillion and $9.7 trillion during 2005-2030.[20]

As energy demands mount, many countries will become increasingly vulnerable to price shocks, because most are heavily dependent on fossil fuels to meet the bulk of energy demands and yet are net oil importers with high oil intensity (that is, oil consumed for each unit of gross domestic product).[21] The region produces only 9 per cent of the world's crude oil supply, while consuming about 26 per cent.[22] Vulnerabilities linked to energy import dependence, aggravated by the volatility of energy prices, will continue to have far-reaching implications for the financial ability of countries in the region to meet their energy demands.

Meanwhile, the International Energy Agency (IEA), in the 2010 edition of its *World Energy Outlook*,[23] indicated that a peak in *conventional* oil production[24] had already occurred. According to IEA's forecast, the most likely scenario is for crude oil production to stay on a plateau at about 68 to 69 million barrels/day. In this scenario, crude oil production "never regains its all-time peak of 70 million barrels/day reached in 2006," due to rising oil prices, declines in investment by the oil industry, and new commitments by some nations to cutting greenhouse gas emissions.

The projected flat crude oil production does not translate into an immediate shortage of fuels for the world's cars and trucks. The IEA projects that the total production of "petroleum fuels" is most likely to continue rising steadily, reaching about 99 million barrels/day by 2035. This includes oil supplied through enhanced recovery means from non-conventional oil sources (such as oil shale or tar sands).

There are also serious concerns about the development of renewable energy sources, particularly biomass. Bioenergy growth has implications across the development spectrum. As discussed in the section below on food security, there are major issues of competition between food and fuel crops. The International Resource Panel concludes that both land and water are limiting factors for biofuel production and proposes policies that emphasize system-wide increases in resource productivity, including adjusting targets to levels that can be sustainably supplied.[25]

In addition, while nuclear electricity generation is projected to increase rapidly in such countries as China and India to improve energy security, diversify energy sources and reduce carbon dioxide (CO_2) emissions, this option creates risk and liabilities.[26] The March 2011 Fukushima Daiichi nuclear disaster in Japan has renewed debate about the future of large-scale nuclear power generation. Operational safety in earthquake and tsunami-prone areas, such as the Asian and Pacific region, has an obvious bearing on future investment.[27]

Given the region's rising energy demands and the current limitations of other options, coal will continue to play a large role in electricity generation, especially in countries with large coal reserves (for example, China, India, and Indonesia). Unfortunately, the burning of coal generates large quantities of both global and local pollutants, making this option incompatible with climate change mitigation objectives.

Minerals, metals and other materials

The extraction and consumption of non-renewable resources, such as minerals and metals, have also experienced rapid growth in the region. As discussed in more detail in Chapter 2, material consumption in the Asian and Pacific region in 1995-2005 grew by about 50 per cent

from 23.6 billion tons to around 35.3 billion tons; the region accounts for approximately 58 per cent of the world material consumption, while representing approximately 30 per cent of the world gross domestic product (GDP).

Concerns about the limits of supplies of key materials mirror the concerns about peak oil. For such metals as gold, silver and copper, the stock of processed and manufactured metals is now estimated to be equivalent to or larger than the stock yet to be mined. Underground reserves of other metals, such as iron, cobalt, platinum and palladium, are projected to be close to exhaustion by 2050.[28] In the short and medium term, scarcities will translate into higher prices, and in the long term may disrupt production processes and hamper economic growth.

Signals that supplies of rare earth metals used in low-carbon technologies—in particular wind turbines, hybrid vehicles and all kinds of information and communication technologies (ICTs)—are constrained,[29] caught the attention of technology producers in July 2010 when export restrictions on these metals were tightened.[30] Developments in the supply chain of critical minerals may, without investment in expanding alternative supplies and managing demand, dampen the currently optimistic outlook for the role of technology in achieving low-carbon growth.

Similar issues exist in the agriculture sector. Some experts predict that global phosphorous production, of which 90 per cent is accounted for by a handful of countries, will peak by 2035.[31] Demand management via a shift to eco-efficient farming and recovery and reuse of phosphorous from wastewater may be required on a large scale to maintain global food production.

Water security

The Asian and Pacific region has the world's largest share of renewable freshwater resources, but, on a per capita basis, has the lowest availability of water—5,224 cubic metres per capita compared with the world average of 8,349 cubic metres. The region supports about 60 per cent of the world's population with 38 per cent of the world's water resources. On average, about 11 per cent of its total renewable resources are withdrawn annually, second in the world after the water-scarce Middle East and on par with European utilization rates.[32]

In water-stressed countries, the demand for water from urban and industrial centres, as well as from agricultural activity, is competing with the need for water to sustain ecosystems and their services on which peoples' livelihoods depend. As populations grow and urbanization rates rise rapidly, and where regulatory regimes are unable to reduce pollution loads, stress on the region's water resources is intensifying. Furthermore, while effective water sharing arrangements will be increasingly needed to avoid environmental and economic disasters at the regional level, this has long been a sensitive issue in many places, for example between countries in South Asia and even between states, as in India.

The availability of water is a major factor in food security, as nearly 70 per cent of freshwater withdrawals are for agriculture, mainly for irrigation. However, high proportions of water for agriculture do not always translate into benefits for reducing poverty and hunger. This situation is extreme in India, Pakistan, Sri Lanka, and Tajikistan—all water stressed countries—where more than 90% of water is used for agriculture, yet more than one in five people in these countries remained undernourished in 2005. Therefore, to address both water security and food security simultaneously, one of the major challenges will be to improve the performance of both irrigated and rainfed production to produce "more crop per drop."

In addition, water needs for energy production are increasing with energy demand. For instance, in China, declining water availability has emerged as a major problem for the energy sector, which uses one fifth of all water consumption.[33] It is a problem being faced wherever there is accelerating energy demand, even in the United States.[34]

Furthermore, water quality in many countries of the region is in decline. Population growth, growing water consumption, pollution from agricultural and industrial activities, poor management of water catchment areas and groundwater overuse are partly responsible for this situation. Most major cities of the region, even in relatively water-rich countries, such as Malaysia and Indonesia, are facing water supply and quality constraints. The problems

are large: 80 per cent of the region's rivers are polluted and/or otherwise compromised by unsustainable development.[35] Many countries of the region have been characterized as "water hotspots" (Box 1.2).

In some areas, climate change will further aggravate water shortages by causing longer and more extreme droughts, further undermining food security. In other areas, climate change will lead to extreme rainfall events, thereby increasing

Box 1.2: Water hotspots

The Economic and Social Commission for Asia and the Pacific (ESCAP) has worked with water experts to explore ways to better prioritize investments in improving the security of water services, in a context where water resource management challenges are becoming more complex. A regional water assessment framework has been proposed to identify water "hotspots" by examining indicators of (a) the socio-economic and environmental outcomes of water use, and (b) the capacity of communities or countries to deliver expected outcomes in an equitable and sustained way.

The socio-economic and environmental outcomes of water use are assessed based on indicators of access to water and sanitation, health and patterns of water use, while the capacity of communities or countries to deliver expected outcomes is assessed based on indicators and qualitative assessments of water availability, vulnerability and risk (disaster, ecosystems and climate change), and investment capacity. Significant shortcomings, threats or vulnerabilities in multiple parameters are interpreted as indicating a high level of insecurity in relation to water services.

According to these indicators, the countries with the most important challenges in relation to water security are Cambodia, India, Indonesia, the Lao People's Democratic Republic, Myanmar, Papua New Guinea, the Philippines, Thailand and Uzbekistan, where there are shortfalls in positive socio-economic outcomes of water use and in the capacity to deliver these outcomes.

In these countries, investment is needed to ensure that access to water for various purposes, as pre-requisite for enhancing socio-economic progress, can be secured. For the countries of greatest concern according to this approach to defining water security, the main issues are vulnerability to climate and environmental change, together with the evidence that these countries have not been able to provide adequate access to water and/or sanitation.

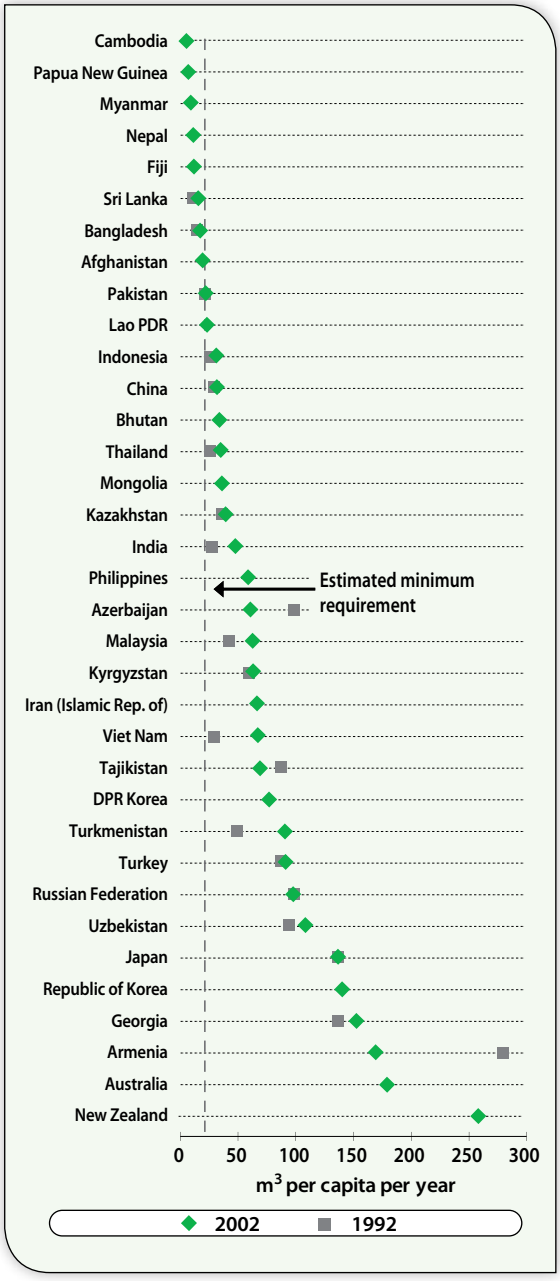
With further investment in indicator development, data collection and interpretation, this proposed framework for exploring water hotspots can help to prioritize infrastructure, policy and capacity investments in a way that reflects the multiple dimensions of water security.

Table 1.1: Access to improved drinking water and sanitation, 2000 and 2008

Subregion	2000		2008	
	Population ('000)	%	Population ('000)	%
Improved drinking water				
North and Central Asia	200 291	93	202 088	94
East and North-East Asia	1 214 112	81	1 395 991	90
Pacific	27 517	88	30 673	88
South and South-West Asia	1 247 509	82	1 515 162	87
South-East Asia	414 154	80	493 042	86
Total with access to improved drinking water	3 103 582		3 636 956	
Total Asia and the Pacific without access	664 609		480 608	
Improved sanitation				
North and Central Asia	189 818	87	192 180	88
East and North-East Asia	815 267	55	925 595	60
Pacific	27 037	87	30 348	87
South and South-West Asia	517 532	34	659 207	38
South-East Asia	306 150	59	395 345	69
Total with access to improved sanitation	1 855 804		2 202 675	
Total Asia and the Pacific without access	1 912 387		1 914 888	

Source: Economic and Social Commission for Asia and the Pacific, based on data from the Joint Monitoring Programme for Water Supply and Sanitation, 2010, accessed from www.wssinfo.org/datamining/introduction.html on 17 September 2010.

Figure 1.1: Domestic water use per capita , 1992 and 2002



Source: AQUASTAT, accessed from www.fao.org/nr/water/aquastat/main/index.stm on 11 July 2010.

the incidence of severe flooding.[36] Hundreds of millions of South Asians face growing water stress due to over-exploitation, climate change and inadequate cooperation among countries.[37]

The long-term effects of glacier melt under climate change include reduced river flows that will reduce supply to downstream countries and dry up some perennial sources of potable water and irrigation.[38,39] The glaciers of the Himalayas, which regulate the water supply to the Ganges, Indus, Brahmaputra, Mekong, Thanlwin, Yangtze and Yellow rivers and provide water supply to hundreds of millions of people in these water basins, are vulnerable to global warming, but the overall situation is complex.[40] Similarly, much of Central Asia depends on the Amu Darya and Syr Darya rivers, which emanate from glaciers in the Pamir and Tien Shan mountain ranges. These glaciers are shrinking due to climate change.[41]

At the household level, more than three out of four Asian and Pacific countries seem to be meeting their populations' basic water needs (see Figure 1.1).[42] However, despite significant progress during 2000-2008, 480 million people in the region still had no access to safe drinking water in 2008; also, 1.9 billion people had no access to improved sanitation in 2008, showing little change relative to 2000 (Table 1.1). Pervasive inequity in service provision exists. Urban and upper classes are connecting to water services at a much higher rate than rural and poor households.[43]

Many countries experience shortfalls in service provision. Leakage, inefficient domestic water use, or underinvestment in providing access, especially in rural and slum areas, are still basic challenges. People in Afghanistan, Bangladesh, Cambodia, China, Fiji, Kazakhstan, Myanmar, Nepal, Pakistan, Papua New Guinea and Sri Lanka, and are likely to be particularly vulnerable to water shortages (Figure 1.1). Inadequate water quality further reduces the availability of water.

Providing water and sanitation services to everyone requires sizeable financial resources. It is estimated that the region needs a total of $59 billion to meet the MDG target of access to water and $71 billion to meet the MDG target of access to sanitation.[44] If investment needs for all water services are included, the total annual investment costs for water infrastructure could reach $180 billion, including about $100 billion for all developing countries in the region.[45]

Food security

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.[46] This definition, from the World Summit on Food Security held in Rome, 2009, has four pillars with regard

to food supplies: availability or adequacy (either domestically grown or imported), stability, access, and utilization of food (at the household level).

While agriculture on a global scale produces 17 per cent more calories/person today than 30 years ago (at the beginning of the green revolution),[47] there are growing concerns about both the adequacy and stability of food supply, particularly in the light of continuing food price rises.

Food supply is being affected by a number of factors, including low crop yields; rising input costs (for example, energy and fertilizer); increasing scarcity of and competing demand for freshwater; loss of farm land for housing and industry; competing use of land and food grains for biofuel; and neglect of investment in agricultural technology, infrastructure, processing facilities, and—not least—agricultural research and development.[48] In many areas, climate change is multiplying these challenges.[49] Without action to increase the supply of food, 10 million more people could fall below the $1.25 a day extreme poverty line in the near future.[50]

Food security is of particular concern, since about 545 million people in Asia and the Pacific still consume less than the global standard of 2,200 calories/day, while many more suffer periods of relative deprivation due to seasonal variation in food availability. About 28 per cent of children under five are underweight due to malnutrition, and the proportion of undernourished population has even increased in some subregions (Table 1.2). About half of the countries in the region have average calorific intakes that are more than 45 per cent above minimum requirements, but more than 20 per cent of the population is undernourished in many Asian countries, including Armenia, Bangladesh, Cambodia, the Democratic People's Republic of Korea, India, Mongolia, Pakistan, Sri Lanka, Tajikistan and Timor-Leste.[51]

Meanwhile, demand continues to grow. More than 60 per cent of total cereal demand by developing countries will still come from Asia by 2030; global production will need to increase by 40 per cent by 2030 to keep pace with global demand[52] The increase is due not only to a growing world population, but also strong income growth in emerging economies and the change in diets towards meats and processed foods that use more food crops for feedstock and inputs.[53]

In many places, agricultural intensification may, in the short term, help meet demands, while reducing poverty and hunger. However, it may do so by compromising long-term prospects for meeting food security needs. Intensive farming will drive regional demand for water, further impacting water security in some places. Furthermore, intensive farming techniques and heavy use of chemical fertilizers have caused land degradation, water pollution, greenhouse gas emissions, and changes in nitrogen cycles. Also of concern is the contamination of air, soils and water from the release of persistent organic pollutants produced for use as pesticides and other agricultural chemicals.

Severe degradation has taken place in three quarters of agricultural land in South and South-East Asia as a result of wind or water erosion, overgrazing, or chemical pollution. Desertification is widespread across Central Asia, the Islamic Republic of Iran, and Afghanistan; in China, more than 3.5 million square kilometres are eroded, in areas mostly occupied by the poor.[54] Much of the problem is due to large-scale intensive monoculture.

Table 1.2: Proportion of undernourished population, 1990-1992 and 2005-2007

	1990-1992	2005-2007
Southern Asia	21	21
South-Eastern Asia	24	14
Eastern Asia, excluding China	8	12
Eastern Asia	18	10
Western Asia	5	7
Oceania	12	13

Note: Subregion designations are as indicated on the list of the official MDG Regional Groupings; available at http://mdgs.un.org
Source: United Nations, *The Millennium Development Goals Report, 2010* (New York, 2010).

Another notable trend is that, although agricultural production has been expanding more rapidly in the Asian and Pacific region than the world as a whole for several years, the region has been a net importer of agricultural products since the 1990s.[55] The food price crises in 2007/2008, when such countries as India and Viet Nam suspended cereal exports, and 2010/2011, when natural disasters led Russia to ban wheat exports for nearly one year, demonstrate that over-reliance on imports can leave countries particularly vulnerable to supply interruptions.

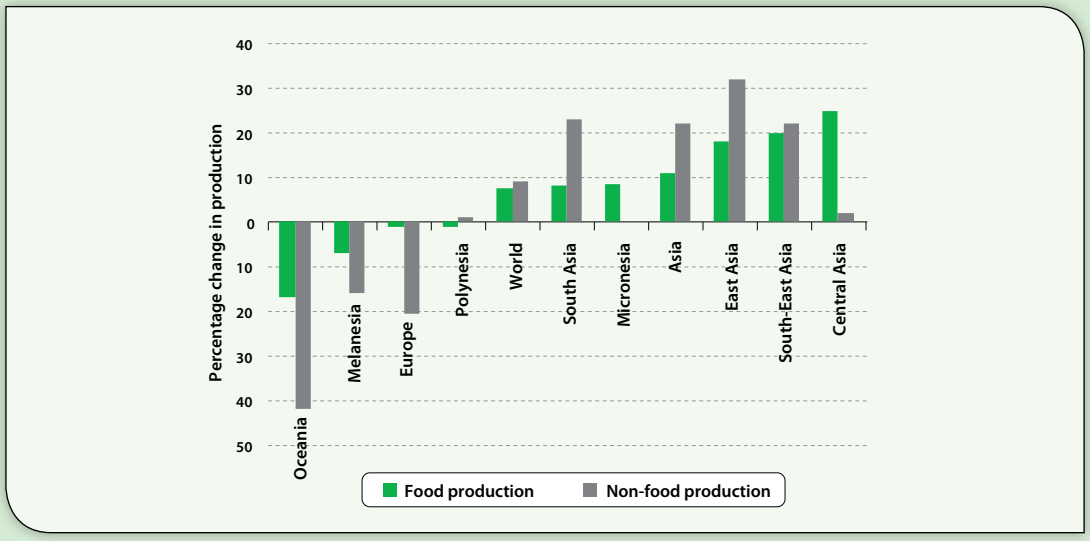
Wealthier countries with more limited access to land have sought to secure access to land for agricultural production in other countries, including in the Asian and Pacific region. Government-to-government agreements have been recorded with investments directed to food and agro-industrial production in Cambodia, Indonesia, the Lao People's Democratic Republic, Pakistan, the Philippines, and Turkey. The International Food Policy Research Institute has attributed these investments by countries short in land and water, and able to afford it, to the effects of the food crisis, "pressures on natural resources, water scarcity, export restrictions imposed by major producers when food prices were high, and growing distrust in the functioning of regional and global markets." These factors have led countries short in land and water to find alternative means of producing food.[56]

Box 1.3: Food and non-food production

For the region as a whole, production of non-food crops is growing faster than production of food crops. This is particularly the case in South Asia and East Asia (see Figure below). Because more than half a billion people in the Asian and Pacific region were already undernourished as of 2004–2006,[a] these trends present a significant challenge, especially given the projected food price increases and volatility, climate change impacts and population growth.

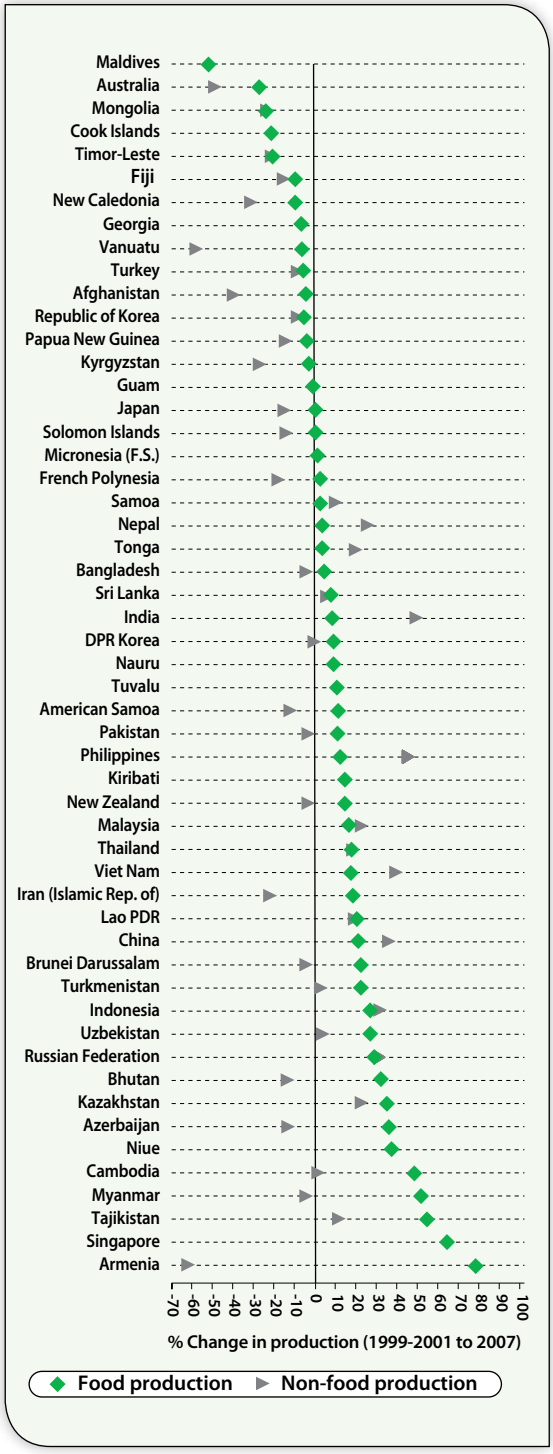
Increases in non-food production relative to food production are relatively large even in China, India, the Philippines, and Viet Nam where hunger and/or undernourishment persist or are growing. In such countries, land use, agricultural investment strategies and institutional arrangements that impact on access to sufficient, safe and nutritious food require particular attention.

Changes in food and non-food production, indexed 1999–2001 to 2007



Note: Subregion designations are as used by the Food and Agriculture Organization of the United Nations (FAO).
Source: FAOSTAT, accessed from http://faostat.fao.org/default.aspx on 6 June 2010.
[a] Economic and Social Commission for Asia and the Pacific estimate based on data from Millennium Development Goal database.

Figure 1.2: Changes in food and non-food production of Asian and Pacific countries, indexed 1999–2001 to 2007



Source: FAOSTAT, accessed from http://faostat.fao.org/default.aspx on 6 June 2010.

An obstacle to the much-needed expansion of food production is incentives to grow crops for biofuels (Box 1.3). An estimated 8 to 34 per cent of total cropland would be required to provide 10 per cent of transport fuel demand with current first generation biofuel technologies.[57] The World Bank has called for food producing countries to relax export controls and divert production away from biofuels to prevent millions more people being driven into poverty.[58]

Yet another factor influencing the ability of countries to produce enough food is extreme weather events, as well increasing water stress. In an average year, Asia incurs $39.5 billion in physical losses due to natural disasters. Since weather-related hazards cause about two thirds of natural disasters in the Asian and Pacific region, the effects of climate change, which is expected to increase weather variability and extreme events, could result in more frequent and more damaging events.[59] The Intergovernmental Panel on Climate Change has concluded that rice yields could decline by 50 per cent on average by 2100, relative to the1990 level.[60]

The Food and Agriculture Organization of the United Nations (FAO) has also drawn attention to the enormous global waste of food.[61] About one third of food produced for human consumption, some 1.3 billion tons/year, is lost or wasted globally along the food chain, mainly during processing in developing countries and at the consumption stage in developed countries. This represents a huge waste of food and energy resources and greenhouse gas emissions. Greater awareness raising along all parts of the food supply chain is needed and, in developing countries, improvements in harvesting, storage, and processing will be required.

With regard to access, the third pillar of food security, many people can neither grow nor afford to buy enough food. The green revolution increased supplies and kept cereal prices from rising but could not help many of the poor increase access to food. Lacking access to substitutes (such as home-grown food), urban poor are at particular risk. Also troubling, some countries exhibit undernourishment rates higher than expected given overall average calorific intakes—as in China, India, the Lao People's Democratic Republic, Pakistan, Vanuatu and Viet Nam.[62]

Further, while cereal production became more industrialized to provide markets with a steady supply, many small producers became marginalized, unable to access these markets.[63] Among other barriers, small producers have trouble complying with international food standards and regulations. At the same time, imported foods may out-compete local produce, especially when subsidized.

The fourth food security pillar, utilization, is largely a measure of households' ability to make use of food, which becomes a problem for the poor who suffer from inadequate or contaminated water supplies and poor sanitation, thus reducing the quality of their food or making it hazardous. Other utilization issues concern food that is contaminated, or badly stored, processed or prepare.[64]

Finally, food security requires "safe and nutritious" food with appropriate nutritional content, not simply adequate calories. The difference is seen in the double burden of under- and over-nutrition that plagues much of Asia.[65] In the Pacific islands, poor quality imported foods have resulted in their populations having the highest rates of obesity and type 2 diabetes in the world.[66] Under present food and trade policies in most countries, these health trends will continue to worsen as prices continue to favour consumption of low quality foods, particularly by the poor. More aggressive policies and strategies are needed to reverse the trend through proactive awareness programmes and education on proper nutrition at all levels, together with agricultural policies that promote production of more diverse, healthy and affordable foods.

The ability of countries to respond to all of these challenges will determine whether or not they can feed their populations adequately in the face of price spikes and upward pressure on food prices. As illustrated in the course of 2007 and 2008, such price pressures can have serious adverse social consequences, with the poor suffering most. Thus, efforts to improve food security[67] will require agriculture to be more sustainable and more diverse to guard against future shocks (see Chapter 3).

On a more positive note, there has been a perceptible shift in strategies to secure food. After several years of supporting market-orientated food security strategies, self-sufficiency in food has been re-emphasized by many governments, including Indonesia, the Philippines and Thailand. In response to rising food prices, measures to step up domestic agricultural production were put in place and some governments identified food production as a future "growth" sector.[68]

Ecosystems and biodiversity

The Asian and Pacific region's biodiversity and abundant natural resources provide sustenance and livelihoods for millions of people—from seafood and agricultural products to livestock fodder, fuel wood, timber and medicine. The region is one of the globe's richest regions in terms of biodiversity—it contains four of the 12 "mega-diversity" countries, and about 60 per cent of the world's species.[69]

Ecosystem services, described as the benefits provided to humans from ecosystems, are the basis for human life. Four types of ecosystem services are defined by the Millennium Ecosystem Assessment:[70]

- provisioning services (such as provision of food and freshwater),
- regulating services (such as climate regulation, water purification and flood regulation),
- support services (such as nutrient cycling and soil formation), and
- cultural services (such as aesthetic, educational, spiritual and recreational values).

As economies and populations grow and as climate change develops, the demand for such services increases. In India, where 480 million people directly depend on small farming, animal husbandry, forestry and fisheries, the contribution of ecosystem services to the economic value accruing to these people was estimated at some 57 per cent, compared with the estimated contribution to the entire economy of 7.3 per cent.[71]

The capacity to deliver ecosystem services is tied to ecosystem health and productivity. Overuse of environmental resources affects the supply, health and diversity of ecosystems and their services from which all economies and societies benefit. Environmental degradation can reduce the flow of those services or result in inequitable and unsustainable trade-offs; for example, the use of land to produce agro-industrial products for export can disrupt the functioning of watersheds

that produce water to meet both agricultural and other needs.

In Asia and the Pacific, as elsewhere, resource use is driving changes in regional ecosystems and affecting the supply of ecosystem services, such as those provided by forests and wetlands (Box 1.4).

As of 2008, the region had the highest number of threatened species in any of the world's regions—almost one third of all threatened plants and over one third of all threatened animal species.[72] The ecosystems of the Greater Mekong Subregion, which supports more than 300 million people,[73] the Coral Triangle, whose marine and coastal

Box 1.4: Forest and wetland degradation in Asia and the Pacific

While Asia registered a net gain of some 2.2 million hectares of forest annually in the last decade, this was largely due to the expansion of forest plantations based on non-native species (in China, India and Viet Nam, large-scale afforestation programmes contributed to the annual expansion of forest area by a total of nearly 4 million hectares in the last five years). In many other countries, rapid conversion of forested lands to other uses has continued.[a] Total loss of forest cover appears to have accelerated in Afghanistan, Armenia, Cambodia, Malaysia,[b] Pakistan and Sri Lanka.

Overall, and despite expanded forest cover, these trends have resulted in large decreases in forest biomass, which serves to sequester carbon.[c] Other globally and locally important ecosystem services, including critical biodiversity habitats, are also affected. Locally important ecosystem services, such as disaster mitigation and watershed regulation, are also likely to be reduced when forests in specific areas are degraded.

Mangrove forest cover has been reduced in most Asian and Pacific countries, with losses concentrated in South-East Asia between and 1990 and 2005, with the laudable exception of Bangladesh, which expanded mangrove cover by some 16,000 hectares.[d] In that country, in which both vulnerability to natural disaster and food security are of concern, this investment should mitigate the impact to the seasonal storm surges, while also providing support for marine fisheries stocks, an important source of protein. Viet Nam's rapid loss of mangrove forest has been recognized as increasing vulnerability to climate change and has prompted a significant investment in mangrove replanting.

In addition, about 4 per cent of listed wetlands (covering a combined area of 1,238,573 hectares over 8 sites) are listed by the Ramsar Convention's Montreux Record as having

continued on next page.

Average annual change in forest area, 1990-2000 and 2000-2007

Source: FAOSTAT, accessed from http://faostat.fao.org on 17 September 2010.

undergone changes in ecological character, or are under threat of such changes. Many more are likely to be threatened.

The Asian and Pacific region has 353 wetlands listed under the Ramsar Convention, covering some 37,694,623 hectares. The largest areas of listed wetlands are found in the Russian Federation, Australia, Kazakhstan and China. The Marshall Islands has one designated wetland, Jaluit Atoll Conservation Area, covering 69,000 hectares or almost four times the size of its land area.

[a] *UN-REDD Programme Newsletter*, No. 7, March/April 2010, accessed from www.un-redd.org/Newsletter7_FAO_FRA_2010/tabid/3923/language/en-US/Default.aspx on 28 January 2011.
[b] In a recent report, Wetlands International (2010) estimated that Malaysia was uprooting an average of 2 per cent of the rain forest a year in Sarawak. In the last 5 years, it was estimated that approximately 0.87 million acres of Malaysia's peatlands were deforested, or one-third of the swamps, which have stored carbon from decomposed plants for millions of years and are home to several endangered animals. According to the report, most of it is being converted to palm oil plantations. *Source*: Wetlands International, *A quick scan of peatlands in Malaysia* (Petaling Jaya, Malaysia, Wetlands International-Malaysia, 2010) 50 pp.
[c] Wetlands International, *A quick scan of peatlands in Malaysia* (Petaling Jaya, Malaysia, Wetlands International-Malaysia, 2010) 50 pp.
[d] FAOSTAT, accessed from http://faostat.fao.org on 17 September 2010.

resources support the livelihoods of more than 120 million people,[74] and the forest of Borneo, which represents the largest contiguous forest area remaining in South-East Asia,[75] are all under threat from direct human interference and global warming. Deforestation and land degradation are also significant drivers of biodiversity loss.

As a result, many ecosystem services are in decline, including freshwater, capture fisheries, air and water purification, regulation of regional and local climate and mitigation of natural hazards. For example, at present rates of ecosystem degradation, the Greater Mekong Subregion could lose more than 50 per cent of its remaining land and water habitats over the next century.[76] FAO notes that about 850 million hectares in Asia and the Pacific are affected by some form of land degradation and that "the ongoing threat of climate change adds additional stress to fragile ecosystem services on which the rural poor rely."[77]

The 2010 Global Biodiversity Outlook 3[78] points out that "the provision of food, fibre, medicines and fresh water, pollination of crops, filtration of pollutants and protection from natural disasters are among those ecosystem services potentially threatened by declines and changes in biodiversity." The 2010 Association of Southeast Asian Nations (ASEAN) Biodiversity Outlook stresses the need for multiple measures to enhance the production of agricultural lands, reduce post-harvest losses, undertake sustainable forest management, and change excessive and wasteful consumption patterns in order to reduce biodiversity pressures.[79]

Emerging opportunities

While challenges have multiplied, new opportunities and incentives for improving the sustainability of resource-use patterns have emerged. These include investments in infrastructure development, new technologies and green jobs, changes in consumer markets and stakeholder engagement.

Sustainable infrastructure investments. The region contains some of the largest and fastest-growing cities in the world. The urban population is expected to expand by 0.7 billion between 2010 and 2025. The region's cities and towns will need to provide jobs, housing, water, energy, transport, education, health and cultural infrastructure for an *additional* 120,000 people/day, every day, for the next 15 years.[80] Given the large infrastructure investments currently being planned over the next 20 years, the potential for designing infrastructure, including housing, water and energy, and transport according to principles of sustainability, accessibility, eco-efficiency and social inclusiveness, is enormous (Box 1.5). Such investments would help to slow the growth in demand for key resources, as well as allow greater and more equitable access to essential urban services. [81, 82, 83] In addition, it is now recognized that "ecosystem-based climate adaptation" measures can often be more sustainable and cost effective in the long run than constructing costly human-made structures.

Technologies and green jobs. Renewable energy technologies are maturing and countries of the Asian and Pacific region are now global leaders

Box 1.5: Sustainable infrastructure investment opportunities

Investment opportunities in sustainable infrastructure are potentially numerous and vary from country to country. While the purpose of this chapter is not to formulate recommendations, the following list of potential opportunities may be of interest.

Clean energy. As the region aims answer the growing energy demand, it should examine the possibilities to promote and invest in clean, efficient and climate-resilient energy systems, emphasizing energy efficiency, renewable energy, access to energy for all, energy sector reforms, capacity building and governance.[a,b,c]

Liveable cities. With the increasing urbanization of the region, there will be significant benefits to developing climate resilient and liveable cities emphasizing: integrated urban planning; improved access to urban water and sanitation services; enhanced waste management services and infrastructure; sustainable urban transport; energy efficiency of residential and commercial buildings; and reducing risks and increasing the resilience of vulnerable urban areas to the impacts of climate change and natural disasters, among other investment opportunities.[d] Urban planning that provides for sustainable transport is critical.[e]

Sustainable transport. It has become clear that transport infrastructure, regardless to its capacity, will not be able to accommodate the ever increasing number of private vehicles, and that congestion and air pollution are costing national economies a large percentage of their gross domestic product (GDP). Shifting towards energy-efficient and sustainable modes of transportation (for example, urban rail and bus rapid transit, as well as non-motorized transport), with a focus on investments in clean, low-carbon, climate-resilient, safe, efficient, accessible and affordable transport systems will provide significant benefits to urban populations of the region. This will require a combination of more holistic policies and planning that focus on demand management (for example, congestion pricing), especially in the urban development context but also in intercity transit and freight transport systems.[f,g]

Water and sanitation. As water stresses are projected to continue to increase, improving access to reliable and affordable water infrastructure and services for safe water and sanitation, while reducing climate and natural disaster risks and increasing the quality and sustainability of surface water and groundwater through integrated water resources management and conservation, is of greater necessity than ever before.

Irrigated agriculture. The agriculture sector consumes the largest share of water, partly as a result of considerable inefficiencies in its use. A more eco-efficient agricultural sector that minimizes or avoids the negative impacts of intensive agriculture related to the intensive use of chemical, energy and other inputs, while maintaining productivity, will require efficient irrigation systems as well as climate-resilient, improved crop varieties and cropping systems.

[a] Asian Development Bank, *Improving energy security and reducing carbon intensity in Asia and the Pacific* (Manila, 2009).

[b] ADB is supporting development of "efficiency power plants" in China; see: Asian Development Bank, *Report and recommendation of the President, proposed multitranche financing facility and administration of grant from the clean energy fund, People's Republic of China: Guangdong energy efficiency and environment improvement investment program* (April 2008) (Asian Development Bank, Project Number: 39653).

[c] Asian Development Bank, *Report and recommendation of the President: Philippines energy efficiency project*, (Manila, January 2009) (Asian Development Bank, Project Number 42001).

[d] Extended discussion of the various challenges and successes posed by rapid urban growth can be found in: Brian Roberts and Trevor Kanale, *Urbanization and Sustainability in Asia–Case Studies of Good Practice* (Manila, Asian Development Bank, 2006). Accessed from http://www.adb.org/Documents/Books/Urbanization-Sustainability/ on 9 December 2010.

[e] Asian Development Bank, Managing Asian cities: sustainable and inclusive urban solutions (Manila, Asian Development Bank, 2008). [Report prepared under Regional Technical Assistance 6293: Managing the Cities in Asia.] Accessed from www.adb.org/Documents/Studies/Managing-Asian-Cities/mac-report.pdf on 13 May 2011.

[f] Asian Development Bank, Changing course: a new paradigm for sustainable urban transport. (Manila, Asian Development Bank, 2009), accessed from www.adb.org/Documents/Books/Paradigm-Sustainable-Urban-Transport/default.asp on 7 January 2010. Also see Holger Dalkmann and Charlotte Brannigan, Transport and climate change, module 5e, sustainable transport: a sourcebook for policy-makers in developing cities, (Eschborn, Germany, GTZ Division 44, 2007); accessed from www.gtz.de/de/dokumente/en-transport-and-climate-change-2007.pdf on 4 July 2010.

[g] Electric bikes and scooters have great potential to reduce transport-related air pollution, but quality and reliability are still an issue in markets outside China. See Asian Development Bank, Electric two-wheelers in India and Vietnam, market analysis and environmental impacts (Manila, Asian Development Bank, 2009).

in producing such technology. The creation of "green jobs"—"the direct employment created in economic sectors and activities, which reduces their environmental impact and ultimately brings it down to levels that are sustainable"—is an important strategy for merging social, environmental and economic concerns.[84] Global investment in renewable energy is projected to translate into 20 million jobs in that sector by 2030. Many of these jobs will be created in such countries as China and India, which are focusing on developing renewable energy as a way of improving energy security and boosting their economies. Many green jobs in the energy sector will also emanate from the production of bioenergy, which is creating new opportunities in the agriculture sector.

Market changes. There is growing potential for engaging the private sector as an active partner of governments for improving environmental performance.[85] Eco-certification has emerged as a response to the growing market demand for environmentally sound goods and services, with some consumers willing to pay a premium for certified products. Competitive forces are driving improvements in environmental performance of key industries, such as tourism, automobiles and electronics, including information and communications technology.

Opportunities to move beyond improvements in environmental performance towards more fundamental improvements that reflect the entire life-cycle of goods and services will expand as the challenges of operating in a resource-constrained world become more apparent. Consumers are becoming increasingly aware and demanding more socially and environmentally responsible action by corporations. Strengthening regional and subregional markets and intraregional trade and investment will play a key role in realizing this potential. A critical opportunity is presented by a more aware financial sector that sees the benefits of assisting investments in environmental sustainability both at the corporate and household levels.

Stakeholder engagement. Experience with effective partnerships between governments and civil society is increasing. Several decades of experience with community organizations on such issues as rural development, sustainable land and forest management, coastal and marine resources, integrated water resource management, agriculture sustainability and biodiversity protection, show that community empowerment, knowledge networking and institutional innovations can provide local solutions that improve the sustainability of resource management and socio-economic impacts. Such partnerships have improved land and ecosystem management practices on the basis of "co-investment in, and shared responsibility for stewardship."[86] Social and professional networks that are helping to catalyse change and accelerate the sharing of experiences are maturing and growing with the spread of information and communication technologies.

Regional cooperation. As countries of the region develop, their capacity to support other countries through direct investment, technical cooperation or overseas development assistance has also grown. The leadership of such countries as China, Japan and the Republic of Korea on "green" initiatives presents an opportunity for developing mutually beneficial partnerships in the areas of technology transfer, strategy development and joint action on global issues, such as climate change.

Green shoots: investments, commitments and actions

Global and regional commitments

Green growth was adopted at the fifth MCED[87] in 2005 as a key strategy for achieving sustainable development and for achieving MDGs 1 (poverty reduction) and 7 (environmental sustainability) (Box 1.6). Since then, high-level forums and political statements have emphasized the need to promote synergies between economic growth and environmental sustainability in unprecedented ways.[88] Since its adoption by MCED, programmes and actions that have reflected the urgency of taking action have come from various quarters, including intergovernmental organizations, think tanks and governments. Such initiatives have multiplied in the wake of the triple food, fuel and financial crisis.

Box 1.6: Green growth – a strategy for sustainable development

Green growth can be defined as economic progress that fosters environmentally sustainable, low-carbon and socially inclusive development. Pursuing green growth involves outlining a path to achieving economic growth and well-being while using fewer resources and generating fewer emissions in meeting demands for food production, transport, construction and housing, and energy.

Policies and investments that promote green growth seek to improve the "eco-efficiency of growth," which involves minimizing resource use and negative environmental impacts for each unit of benefit generated by the economy. Green growth is a prerequisite for building a green economy. A green economy is characterized by substantially increased investments in economic activities that build on and enhance the earth's natural capital or reduce ecological scarcities and environmental risks—activities such as renewable energy, low-carbon transport, energy- and water-efficient buildings, sustainable agriculture and forest management and sustainable fisheries.

Several global initiatives are taking place under the auspices of the United Nations. These include calls by the Secretary-General of the United Nations for a Global Green New Deal, calling on governments to allocate a significant share of stimulus funding to green sectors, and a Green Economy Initiative, both led by the United Nations Environment Programme (UNEP).[89] The Green Jobs Initiative (by UNEP, the International Labour Organization [ILO], the International Organization of Employers [IOE], and the International Trade Union Confederation [ITUC]) has played a key role in raising the profile of the potential for green jobs and employment creation. These initiatives have emphasized the need to promote synergies between economic growth, resource-use efficiency, and environmental sustainability.

Major international forums have also issued statements of their intention to promote green growth[90] Thirty members and five prospective members of the Organisation for Economic Co-operation and Development (OECD), comprising approximately 80 per cent of the global economy, approved a declaration on green growth in June 2009 and tasked the OECD with developing a green growth strategy, bringing together economic, environmental, technological, financial and development aspects into a comprehensive framework.

The prominence of the green economy and green growth concepts led the General Assembly of the United Nations to request that the 2012 United Nations Conference on Sustainable Development (Rio+20) focus on the green economy as one of the two main themes.[91] The February 2010 Nusa Dua Declaration, adopted by ministers of environment, acknowledges that the green economy concept "can significantly address current challenges and deliver economic development opportunities and multiple benefits for all nations." It also acknowledged UNEP's leading role in further defining and promoting the concept and encouraged UNEP to contribute to this work through the Rio+20 preparatory process.[92]

In the Asian and Pacific region, the April 2010 ASEAN summit concluded in Hanoi with the adoption of the ASEAN Leaders' Statement on Sustained Recovery and Development. The statement documents the leaders' determination "to promote green growth, investments in long-term environmental sustainability, and sustainable use of natural resources in order to diversify and ensure resilience of our economy." At its sixty-sixth session in May 2010, the Economic and Social Commission for Asia and the Pacific adopted the Incheon Declaration on Green Growth, in which members expressed their intent to "strengthen [their] efforts to purse green growth strategies as part of [their] response to the current crisis and beyond."[93] In addition, support to pursue green growth was stated in the 6th MCED Declaration.

National initiatives

Among the countries that have prominently pursued and invested in strategies and policy reform related to the greening of growth are China, Japan, and the Republic of Korea.[94] Japan and the Republic of Korea have established international initiatives to support more environmentally sustainable economic growth.[95] Many other

Figure 1.3: Examples of green policies and initiatives since 2005

countries, including Cambodia, Fiji, Kazakhstan, Maldives and Mongolia, have made major policy statements supporting green growth. Some examples of green initiatives and commitments are highlighted in Figure 1.3.

The Asian and Pacific region is leading the globe in commitments to "green" investments under economic recovery plans. Stimulus investments in low-carbon power generation (renewable energy, carbon capture and storage), energy efficiency (buildings, public transport, electricity grid), and water supply and waste management have been heralded as a major step towards greening growth. Not only were two thirds of the global investments earmarked for green projects from this region, but the region also had the highest share of green investments in total stimulus investments, at about 23 per cent.[96]

1 **AUSTRALIA**
- Green Power accreditation programme for renewable energy

2 **CAMBODIA**
- Green Growth Road Map, 2010

3 **CHINA**
- National Climate Change Programme (2007)
- Long-term Renewable Energy Development Plan (2007)
- Circular Economy Law 2009

4 **FIJI**
- National Employment Centre Decree (2009) - aims to promote green jobs, green productivity and sustainable enterprise development

5 **INDIA**
- National Environmental Policy (2006) - aims to reduce resources use per unit of economic output
- National Mission on Enhanced Energy Efficiency
- National Solar Mission

6 **INDONESIA**
- REDD benefit distribution policy (2009)
- Renewable Energy Program - aim to expand renewable energy to 17% by 2025

7 **JAPAN**
- Basic Law on Promotion of Circular Society (2001)
- New Growth Strategy (2010) - places green innovation as top of seven strategic areas.

8 **KAZAKHSTAN**
- Zhasyl Damu—Green Development Strategy 2030
- Low carbon strategy

9 **MALAYSIA**
- National Renewable Energy Policy and Action Plan (2010)
- Green Building Index (2009)
- National Green Technology Policy (2009)

10 **MALDIVES**
- Carbon neutrality by 2020 (target set in 2009)

11 **MICRONESIA**
- Micronesian Challenge (2005)—conservation of 30% of nearshore marine and terrestrial areas

12 **NEW ZEALAND**
- Waste Minimisation Act (2008) - encourages waste minimization and a decrease in waste disposal

13 **REPUBLIC OF KOREA**
- National Strategy and Five Year Plan for Low Carbon, Green Growth (2008)
- Framework Act and Presidential Decree on Low Carbon, Green Growth
- Green New Deal policy—2% of GDP investment in Green Growth (2009)
- Resource recirculation policy

14 **RUSSIAN FEDERATION**
- Target to increase energy efficiency by 40% by 2020
- Innovations for energy saving and efficiency, renewable energy

15 **SINGAPORE**
- Sustainable Development Blueprint (2009)
- Green Mark Incentive Scheme for buildings (2005)
- Water Efficiency Fund (2007)

16 **THAILAND**
- Alternative Energy Development Plan and target (2008)

17 **VIET NAM**
- Capacity building and infrastructure for certified organic teas
- Payments for ecosystem services pilot policy and projects

18 **PACIFIC ISLANDS: COOK ISLANDS, FIJI, TONGA, TUVALU**
- Ambitious renewable energy targets

The growing interest of governments has been supported by capacity-building activity. The Republic of Korea-funded Seoul Initiative Network on Green Growth, the Japan-funded Kitakyushu Initiative for a Clean Environment, both supported by ESCAP in partnership with member states, and the ESCAP Green Growth Capacity Development Programme have organized policy dialogues and a series of capacity-building events, including within countries. Deeper levels of national and subregional engagement have resulted in policy initiatives and pilot project activities that have been replicated in the field.

Other regional initiatives support country-based efforts, including UNEP's Sustainable Consumption and Production programme and the Asian Development Bank (ADB) Energy Efficiency Initiative, the Carbon Market Initiative, Sustainable Transport Initiative, Cities Development Initiative

Box 1.7: Initiatives to promote investments in natural capital

The *Coral Triangle Initiative* on coral reefs, fisheries and food security provides a framework for six Asian and Pacific countries (Indonesia, Malaysia, the Philippines, Papua New Guinea, Solomon Islands and Timor-Leste) to enhance the management of a 6 million square kilometre area known as "the Amazon of the Seas." It does so through a regional network of marine protected areas, which can help stem losses of marine resources and recover entire ecosystems and is supported by a number of development partners and international non-governmental organizations.

The *Heart of Borneo Initiative* is a joint initiative of Brunei Darussalam, Indonesia and Malaysia to address the considerable loss in forest biodiversity and greenhouse gas emissions from deforestation and degradation on the island of Borneo. The project aims to address these threats through the collaborative development of a comprehensive forest conservation and management plan that will be accepted and implemented by stakeholders. It is supported by such development partners as the Asian Development Bank (ADB), the Global Environment Facility (GEF) and several international conservation organizations.

The *Biodiversity Conservation Corridor Initiative* (BCCI) under the Greater Mekong Subregion (GMS) Core Environment Program aims to mainstream environmental considerations into the GMS Economic Cooperation Program. Through the BCCI, ADB is supporting the creation of biodiversity corridors that are analogous to economic corridors in their function and objectives. Such corridors enlarge the functional boundaries of conservation areas. They help rebuild the connectivity of fragmented natural ecosystems through greater economies of scale, efficiency, and integration of approaches.

Source: Asian Development Bank. *ADB's Flagship Biodiversity Initiatives,* accessed from http://www.adb.org/Environment/biodiversity-initiatives.asp on 3 May 2011.

for Asia, and ecosystem-based initiatives, such as the Coral Triangle Initiative, Heart of Borneo Initiative and Biodiversity Conservation Corridor Initiative in the Greater Mekong Subregion (Box 1.7).

However important and encouraging, these statements of commitment and initiatives face important hurdles in the form of the ever-increasing per capita resource consumption levels and population growth. Reduced environmental pressure and increased resource use that may have been achieved by incremental improvements in the environmental policy framework and technological progress have been all too quickly overrun by rapid economic expansion. Future growth must take place on an increasingly constrained resource base and in a changing economic context. Action to address the environmental sustainability of economic growth has become more important than ever.

In the long term, sustainable development can only be achieved by fundamental changes in the systems that define economic growth patterns—how resources are used to produce goods and services, who uses the goods and services, the nature of the goods and services, and the purposes for which they are used. Any momentum achieved towards green growth by stimulus packages, investments or stand-alone initiatives may be quickly lost unless underlying economic forces and financing mechanisms are directed to keep the "green growth engine" going. For developing countries, the needs are still great. Discussions of "de-growth" or "no-growth" strategies in developed country contexts are not relevant where access to basic services is still insufficient.

New challenges for governance

A changing development context presents new governance challenges at many levels, from international and regional governance structures to individual countries and even communities. To respond to the converging challenges related to climate, energy, food, fuel, land use and water, governance structures and processes must increasingly integrate the perspectives of many different stakeholders across economic,

social and environmental regimes. This will require greater cooperation, coordination and integration among institutions, policies and development agendas.

The need to better manage risk and uncertainty in all dimensions of sustainable development requires governance systems to become far less centralized, expert-driven, compartmentalized, and inflexible. The capacity of governance arrangements to cope with, adapt to and shape change (including incorporating mechanisms for monitoring early warning signs and assessing the implications of emerging issues) will become critical to building more resilient economies and societies. More adaptive and flexible approaches can help transformations in agricultural development, urban planning and natural resource management, among other areas.

Inclusiveness in decision-making must also feature prominently in governance structures and processes, as heightened expectations, awareness and capacity of stakeholders for self-organization will offer opportunities for more constructive engagement. More inclusive governance will likely become increasingly important as resource constraints give rise to conflicts, social tensions and increased vulnerability and uncertainty. Stakeholders will need to be able to participate in formulating suitable responses to local challenges so that transition agendas are not captured by vested interests and decision-makers are held accountable.

A key national governance challenge in transitioning to a green economy will be effectively mainstreaming green growth and environmental concerns into thematic and sector policy frameworks. At a minimum, this will require political will and leadership, strong and predictable public sector management systems, appropriate levels of funding and a governance environment that fosters transparency, accountability and stakeholder consultation.

As discussed above, environmental regulations must be coupled with appropriate incentives and financing arrangements that, to be effective, must be developed through constructive dialogue with stakeholders and be backed by adequate administrative, monitoring and enforcement capacities. In a few cases, such as Cambodia and the Republic of Korea, governments have accorded high priority to different aspects of greening of growth by establishing high-level commissions or committees; in the case of China, it is the responsibility of the highest-level policy-setting body.

At the global level, it is evident that governance systems and practices do not yet meet the multiple and integrated challenges posed by green growth and sustainable development. Challenges include a lack of linkages and integration between governance of the three pillars of sustainable development, shortfalls in performance arising from insufficient alignment of policy and financing arrangements, lack of coherent approaches between institutions working at the global level and structural inefficiencies introduced by overlapping mandates. In ongoing negotiations, it is also evident that there are limitations on the extent to which the World Trade Organization is able to fully support the greening of growth in ways that do not pose a danger to developing countries.

An overview of developments in environmental governance, the future outlook and lessons learned is provided in Chapter 4.

Turning green shoots into green and resilient growth

A new economic reality has emerged since 2005 as resource limitations, along with the impacts of climate change, have become more evident. Predictions of rapid growth for large economies of the region contrast with significant uncertainty and vulnerability, and there is a growing realization that future growth must be achieved on an increasingly constrained resource base. Further, while economic growth continues, poverty reduction and progress towards other MDGs has slowed and may be reversed in some countries. Security of basic needs—food, water and energy—is now more closely tied to resource constraints, a concern increasingly shared by all levels of society.

Although there has been growing awareness about the need to alter current growth patterns and significant steps have been taken in many countries, incremental improvements in environmental policy frameworks and technological progress have been quickly countered by resource-intensive economic growth patterns.

This is discussed in Chapter 2, which identifies and analyses past trends in resource use and their implications.

Chapter 3 describes ways to "overhaul" the economy towards sustainable development through green growth, cautioning that this can only be achieved in the long term by fundamental changes in the systems that define economic growth patterns. Maintaining the momentum achieved towards green growth by stimulus packages, investments or stand-alone initiatives requires that the underlying economic forces and financing mechanisms be directed towards sustaining a "virtuous circle" of green growth through systemic rather than incremental reform.

Furthermore, as discussed in Chapter 5, the need to develop more resilient economies and societies in the face of growing risk and uncertainty has become a prominent concern of policymakers in the region. The response to the 2008 crisis provided evidence that green growth and resilience intersect. Green growth cannot be achieved without the ability to transform in the face of crisis by grasping the opportunities presented in an evolving policy landscape. At the same time, efficient use of resources will allow economies and societies, particularly those in developing countries, to better face an uncertain and resource-constrained future.

Rising risks for all stakeholders, but especially those already most vulnerable, require a more careful look at governance arrangements. A wide range of stakeholders should be engaged in any "green transition" and capacity should be built to respond to different kinds of shocks. Together, policy approaches that promote green growth and specific policy measures that support resilience can help ensure that economies are sustainable over the long term.

CHAPTER 2: RESOURCE USE TRENDS: MATERIALS, ENERGY AND WATER

Introduction

Pressures arising from climate change and the increasing scarcity of water, land, food, nutrients, oil and strategic materials are converging rapidly in an unprecedented manner, at a time when both human populations and affluence continue to rise. Resource use has become an important issue on the political agenda.[1] The question of whether global economies will be able to meet the needs of all people in a resource-constrained future is already influencing political decisions concerning water, energy, land, minerals and other natural resources. These risks threaten prospects for long-term social stability and economic prosperity.

In most Asian and Pacific economies, rapid and resource-intensive economic growth and urbanization, along with the transition from an agrarian resource base to an industrial resource base, have involved a large increase in demand for materials and energy.

Changing production and consumption patterns, technologies, lifestyles and infrastructure development have raised living standards, but have also accelerated degradation of natural capital, the use of resources and the production of waste and emissions, problems that face virtually all governments in the region. Local problems of resource depletion and pollution, such as those related to energy use and land-use change, are also increasingly seen as global issues.

The complex nature of resource risks posed by the scale and speed of economic transition, and resource-intensive patterns of growth in Asia and the Pacific, call for a closer examination of resource use trends. Where poverty reduction gains may already be slowing, resource risks require particularly close examination. If changes are then not made in the way resources are used and managed, key resources will be increasingly inaccessible or unaffordable to large numbers of people. The immediacy of socio-economic risks faced by each country differs depending on consumption and production patterns, natural resource endowments and demographic trends, among other factors. Whether each economy is becoming more or less resource efficient as it grows is an important aspect of environmental and economic sustainability.

This chapter provides new insights into the patterns and trends in natural resource use in Asia and the Pacific, its subregions and individual countries. The analysis in this chapter draws from new material flow accounts developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and some related analysis prepared primarily for the United Nations Environment Programme (UNEP) report *Resource Efficiency: Economics and Outlook for Asia and the Pacific* (REEO).[2] Readers who wish to see more detailed analysis for particular natural resources or individual countries may consult the REEO report.[3]

Resource use trends in Asia and the Pacific

Since the 1970s, economies in Asia and the Pacific have experienced significant restructuring, industrialization and urbanization, which have contributed to improved standards of living for many.

By the start of the twenty-first century, the Asian and Pacific region had become the world's largest resource user, consuming some 35 billion tons of metal ores, industrial minerals, fossil fuels, construction minerals and biomass each year. This

represents about 60 per cent of the estimated 60 billion tons of annual global material use, whereas the region accounts for only about 30 per cent of global gross domestic product (GDP).

As of 2005, the Asian and Pacific region required three times the input of resources as the rest of the world to produce one unit of GDP. In addition, the composition of resources used has changed dramatically in recent decades, and increasing quantities of resources are being sourced from outside the region. These trends, which are expected to continue, will significantly affect the outlook for the region as well as the rest of the world.

The national resource flow accounts presented in this chapter (Box 2.1) assess the physical effects of this major transition, covering the five subregions of Asia and the Pacific (along with most of its countries). In resource flow accounting, natural resource flows are organized and quantified in order to track the amount of materials and energy that are used in any defined system over a certain period of time. The materials remaining in the system are also quantified to create a stock of capital.

Similar to financial accounts, resource flow accounts report on inputs, outputs and accumulation of stocks and could, if implemented on regional and national scales, become critical

Box 2.1: Material flow database for Asia and the Pacific

A comprehensive data set for material flows and material intensity for 1970–2005 that covers most Asian and Pacific countries has been used for this report and is available online at www.csiro.au/AsiaPacificMaterialFlows. Data are presented for four main categories of materials (biomass, fossil fuels, metal ores and industrial minerals, and construction minerals) and 12 sub-categories.

Aspects of material flow methodology not covered by these basic accounts include unused extraction, embodied flows, and material flows by economic activity. In addition, other resource flows, such as water and nuclear power, are not represented, nor are waste and emissions. These aspects could be addressed in more comprehensive national datasets and studies.

Main material categories of the Asian and Pacific material flow accounts

Main material categories	Sub-categories	Items	Main use sectors
Biomass	Primary crops	Cereals, vegetables	Human nutrition and livestock
	Crop residues	Straw	
	Grazed biomass	Grass and hay	Energy and structural material
	Wood products	Timber	
Fossil energy carriers	Coal	Black and hard coal	Energy
	Petroleum	Crude oil	
	Natural gas	Methane	
Metal ores and industrial minerals	Iron ores	Copper, aluminium	Strategic materials for the construction and manufacturing sectors
	Non-ferrous metal ores		
	Industrial minerals		
Construction minerals	For concrete	Sand and gravel	Bulk materials for construction
	For other uses	Dimension stones, gravel	

Data are presented in tons and measure materials that enter the economic process, that is, materials that become commodities. Materials mobilized that do not enter the economic process (that is, unused extraction), such as overburden in mining or by-products in agriculture, are not included.

Source: CSIRO and UNEP Asia-Pacific Material Flow Database, www.csiro.au/AsiaPacificMaterialFlows.

to planning and decision-making in the context of sustainable development. A more detailed description of resource flow accounting is provided in Annex 1.

Rising resource use

Since the 1970s, most countries in Asia and the Pacific have embarked on journeys to become industrialized societies. This change has been enabled and reinforced by large-scale urbanization, reduction in the agricultural labour force, a move to fossil-fuel-based energy systems, rapid growth in the use of mineral resources, and changes in production and consumption systems.

Both agricultural and industrial systems have typical patterns of material and energy flows (or "metabolic profiles").[4] As shown in Table 2.1, the transition from an agrarian to an industrial economy typically results in an increase in per capita materials and energy use by a factor of three to five. While resource-intensive growth has historically not been limited to Asia and the Pacific, the region's challenges are arguably more acute given the region's size and rapid growth.

Material flow data reveal that resource use has risen in the Asian and Pacific region in line with these patterns. In 1970, the region accounted for about 25 per cent of global material use, reflecting the relatively low level of economic development and low material standards of living that characterized much of the region.

In the following decades, the region experienced much higher economic growth rates than the rest of the world. This was reflected in growth rates of annual domestic material consumption[5] of more than 3 per cent from 1970 to 1990, which were well above the rest of the world. Material consumption growth slowed to 2.3 per cent per annum from 1990 to 2000 as a result of the Asian financial crisis and then increased to 6.0 per cent/year from 2000 to 2005 (Table 2.2).

Between 1995 and 2005, material consumption (including biomass, fossil energy carriers, ores and minerals) in the Asian and Pacific region grew by 50 per cent, from 23.6 billion tons to about 35.3 billion tons (Figure 2.1). Since the mid-1990s, the region has accounted for well over half of global material use, overtaking all the other regions combined.

Similar trends have been witnessed with energy use.[6] During most of the last four decades, energy use in Asia and the Pacific grew faster than global energy use and, in 2008, the region used 45 per cent of global primary energy at 231.7 exajoules (EJ).[7] Moreover, primary energy supply and domestic material consumption were highly correlated throughout the whole period. There has been accelerated growth in energy use since 2000, similar to the trend for material consumption.

Table 2.1: Agrarian and industrial metabolic regimes

	Unit	Agrarian	Industrial	Factor
Per capita energy use	GJ per capita	40-70	150-400	3-5
Per capita material use	tons per capita	3-6	15-25	3-5
Population density	People/km^2	<40	<400	3-10
Share of agricultural population	percentage	>80	<10	0.1
Energy use/unit area	GJ/hectare	<30	<600	10-30
Material use/unit area	tons/hectare	<2	<50	10-30
Share of biomass in energy use	percentage	>95	10-30	0.1-0.3

Source: F. Krausmann, M. Fischer-Kowalski, H. Schandl and N. Eisenmenger. "The global socio-ecological transition: past and present metabolic profiles and their future trajectories", Journal of Industrial Ecology (2008), vol. 12, No. 5-6, pp. 637–656.

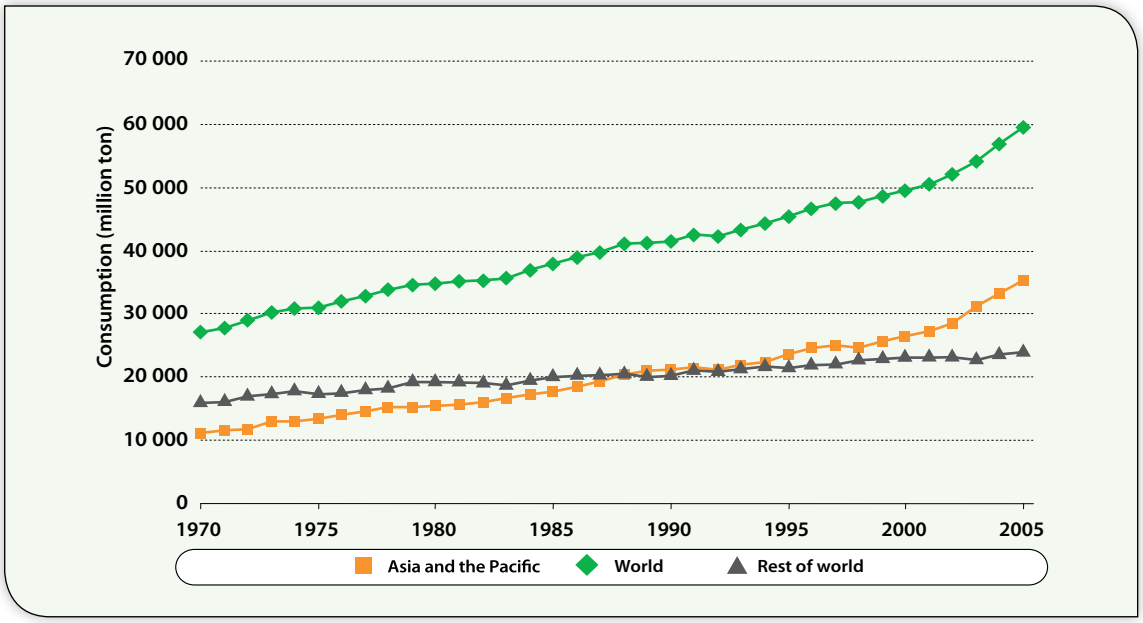
Note : GJ: gigajoule, that is, 10^9 joules.

Table 2.2: Average annual growth rate of domestic material consumption, 1970-2005

	Consumption growth per cent/year			
	1970-1980	1980-1990	1990-2000	2000-2005
Asia and the Pacific	3.2	3.2	2.3	6.0
Rest of world	1.9	0.5	1.3	0.8
World	2.5	1.8	1.8	3.7

Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

Figure 2.1: Domestic material consumption for Asia and the Pacific and the world, 1970–2005



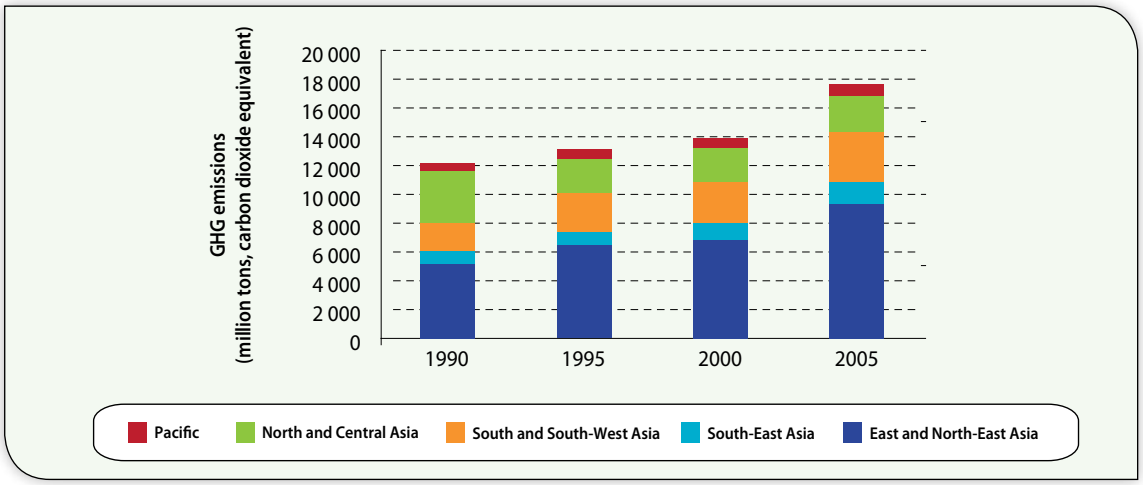
Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

Rising material and energy use commonly results in increased pressures on the environment and growing material stocks, emissions and waste flows. There is, for instance, a close link between growth in material use and carbon emissions because of the use of carbon-intensive products including, but not restricted to, coal for electricity generation; iron, steel and cement for construction activities; and fossil fuel and fertilizer inputs in agriculture.[8]

Following increases in material and energy use, greenhouse gas (GHG) emissions from Asia and the Pacific rose from 14.5 billion to 19.5 billion tons in only 15 years, an increase of 34.5 per cent (Figure 2.2). The rate of GHG emissions growth also accelerated after 2000,[9] mirroring the trends in overall material and energy use. These trends are expected to continue, with developing countries in Asia accounting for 45 per cent of global energy-related emissions by 2030.[10]

While water is usually not covered by material flow accounting, it may be the most important resource of all. Reliable quantities of high quality water are a prerequisite for economic development and well-being. Water is required for many economic activities, including

Figure 2.2: Greenhouse gas emissions in Asia and the Pacific, by subregion, 1990, 1995, 2000 and 2005



GHG: greenhouse gas
Source: World Resources Institute, Climate analysis indicator tool (http://cait.wri.org).

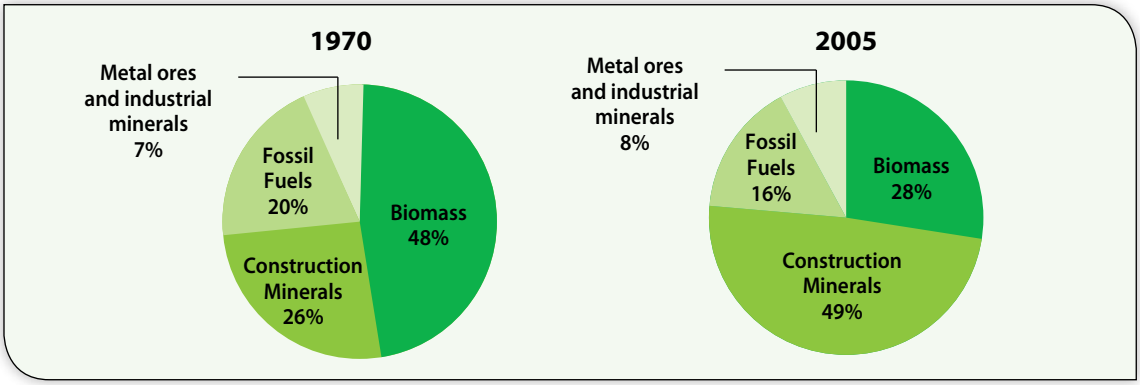
agriculture, livestock industries, manufacturing and households. Many countries in Asia and the Pacific are running down their natural aquifers and water reservoirs faster than they can be recharged. This will have critical repercussions on the availability of water for households, and water for food security and industrial activities (Box 2.2).

A changing resource base

Moving from traditional to modern production systems, technologies and lifestyles involves fundamental changes in material use profiles, away from agricultural systems and biomass, towards urban and industrial systems and mineral materials. This comes with greater amounts of bulk flows, new types of pollution, and new waste streams, creating new challenges for environmental policy at the local, regional and global levels.

Until the 1970s, the Asian and Pacific region's materials use was largely based on biomass. Agricultural crops, animal feed, fuel wood and timber for construction comprised 50 per cent of all materials used. This has changed dramatically over the last three decades. Construction minerals now represent about 50 per cent of all materials used (Figure 2.3). Large amounts of sand, gravel and other bulk construction materials have been used to build cities, transport infrastructure and manufacturing plants in many Asian developing countries to support the growing economic

Figure 2.3: Shares of main material categories in domestic material consumption in Asia and the Pacific, 1970 and 2005



Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

Box 2.2: Water use and intensity in Asia and the Pacific

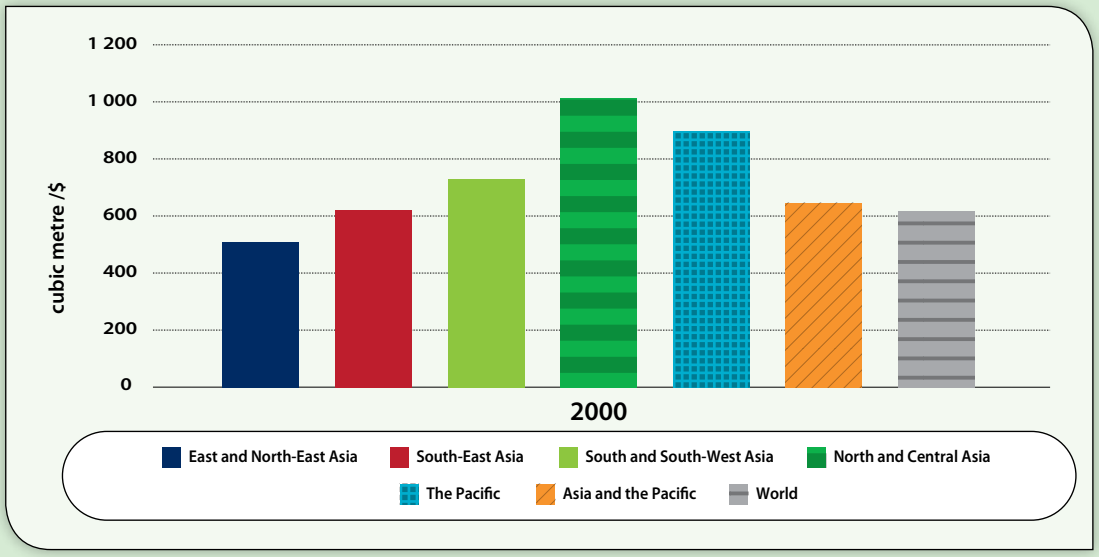
Demand for water in the Asian and Pacific region is expected to soar in the decades to come, leading to severe stress on major river and groundwater systems and rising tensions between users and countries over scarce resources. In contrast to materials and energy, Asia and the Pacific is by far the largest water user globally. In 2000, Asia and the Pacific used 2,383 billion cubic metres (m^3) of water in agriculture, manufacturing industries and households, or about 63 per cent of the 3,765 billion m^3 used globally. The regional average water use of 644 m^3 per capita was above the world average of 619 m^3 per capita. East and North-East Asia used less water than the world average at 509 m^3 per capita, while North and Central Asia was the largest user at 1,011 m^3 per capita.

Agriculture is the biggest user, followed by industry and households. The production of cereals requires especially large amounts of water with a ratio of up to 1,000 tons of water/ton of cereal. In a situation of high water use and shrinking natural reservoirs, efficiency of use becomes imperative.

In 2000, the overall water intensity for Asia and the Pacific was 0.27 m^3/$ compared with the global average of 0.12 m^3/$. The variability in water efficiency ranged from 1.1 m^3/$ in South and South-West Asia to 0.12 m^3/$ in East and North-East Asia, a difference of a factor of 10. This overall picture is caused by large water usage in low-income economic activities and means that water resources are used very intensively while potentially degrading the quality of water for downstream uses. There appears to be significant potential for technical improvements in urban water systems, agricultural water-use practices and water technologies aimed at fostering more effective and less intensive use of this vital resource to produce added economic value and human development outcomes.

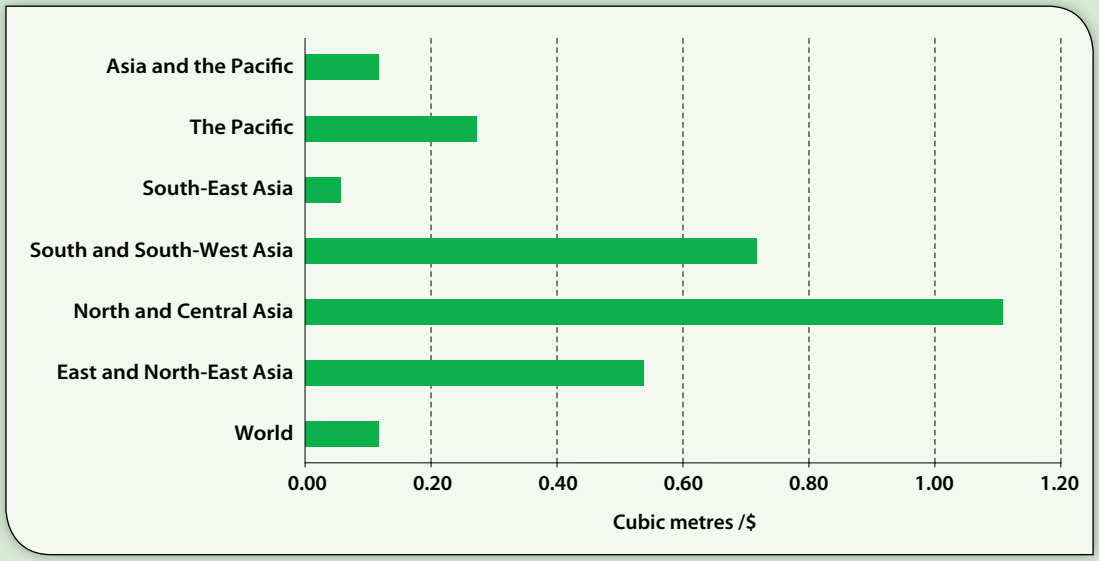
continued on next page.

Per capita water use in the Asian and Pacific region, its subregions, and the world, 2000



Source: AQUASTAT

Water intensity (water use per GDP), 2000



Source: AQUASTAT, World Bank (2000) World Development Indicators

Differences in water intensities between countries are even more pronounced, from highly water intensive countries, such as Tajikistan (13.9 m^3/$) and Turkmenistan (8.5 m^3/$), to relatively intensive countries, such as Viet Nam (2.3 m^3/$), Bangladesh (1.7 m^3/$) and India (1.4 m^3/$), and the least water-intensive economies, such as Australia (0.06 m^3/$), New Zealand (0.04 m^3/$) and Japan (0.02 m^3/$).

Pressure on the region's depleted water resources will continue to rise. Many river basins and groundwater resources face severe stress, accompanied by intensifying competition for water between households, industry and agriculture. By 2025, agricultural water requirements are expected to increase by a factor of 1.3, industry by 1.5 and public demand by 1.8. Many of the transboundary river basins will become stressed or highly stressed, and tensions are likely to increase between nations and between different users.

Source: Food and Agriculture Organization of the United Nations, AQUASTAT, accessed from www.fao.org/nr/water/aquastat/main/index.stm on 11 July 2010; World Bank. World Development Indicators (Washington, D.C., 2009), accessed from http://data.worldbank.org/data-catalog/world-development-indicators on 12 July 2010.

importance of such economies as China, India, Indonesia and Thailand. Growing economic capacity and new business and employment opportunities have also helped to form a new class of consumers who can afford a modern lifestyle with all the commodities that furnish it.[11]

Even though biomass has become less important in relative terms, total extractive pressures have increased since 1970 and are likely to accelerate. The tendency for societies to change to diets richer in animal protein as they become more affluent will increase competition for biomass production from arable land, even if overall calorific demands per capita remain relatively constant. This is due to the low feed energy-conversion efficiencies of animal production systems. Even relatively efficient systems, such as using poultry to produce eggs and meat, typically convert less than 20 per cent of the gross energy contained in feed to energy in the animal products. Beef production systems usually run at conversion efficiencies below 3.5 per cent.[12]

Another expected outcome of rising affluence is higher per capita consumption of transport fuels. As a result of rapid motorization, energy use for transport is expected to increase dramatically up to 2025, accounting for an additional 30 per cent of world energy requirements. In developing Asia, passenger and freight transport energy consumption is expected to increase more rapidly. This will have significant implications for energy demand, pollution (global and local), and energy security across the region.

As discussed in Chapter 1, most countries in the region are importers of fossil fuels, and recent experience has shown that fuel price volatility can have severe impacts on the economy and on the lives of poor and low-income people. This, combined with pressures to reduce fossil fuel dependency, will exacerbate competition for arable land between biofuels and food production. In the case of oil palm and other biofuel feed stocks, expanded cultivation in the Asian and Pacific region has often come at the expense of other crops or of relatively undisturbed forests and wetlands, and often has severe negative impacts on local livelihoods.[13]

Annex 2 presents time series data for domestic material consumption for selected Asian and Pacific countries between 1970 and 2005, for five major material flow categories: biomass, fossil fuels, industrial minerals, metal ores and construction minerals. There are some common features among the national material flow accounts. First, with the exception of Japan, most national economies are using greater amounts of materials. Second, construction materials and fossil fuels are the fastest growing components and are closely linked to growing GDP. Biomass is also increasing but at a slower speed and is closely linked to population and unrelated to GDP growth.

Subregional and country differences in resource use

Asia and the Pacific is a region of great diversity in its levels of economic development, economic structures and resource endowments. As a consequence, subregional and national trends vary considerably. While a few countries in the region have fully industrialized economies and are members of the Organisation for Economic Co-operation and Development (OECD) (Australia, Japan, Republic of Korea and New Zealand), others have only recently started a transition from their pre-industrial, agricultural bases to engage in manufacturing and service activities (most notably China and India). Data on domestic material consumption for selected countries are provided in Annex 2 of this report.

Fewer than 10 countries are responsible for 80 per cent of all materials used. In 1970, the Union of Soviet Socialist Republics was by far the largest user of materials in the region, followed, at some distance, by China, Japan and India (see Table 2.3).

In 2005, China used half of all materials, followed by India (12.5 per cent) and the Russian Federation (6.1 per cent). The speed and scale of China's growth is reflected by the rate of growth in infrastructure investment and cement production. China produced about 10 million tons of cement in 1970, 1.7 per cent of world production. In 2005, China produced over one billion tons of cement representing 45 per cent of world production.[14]

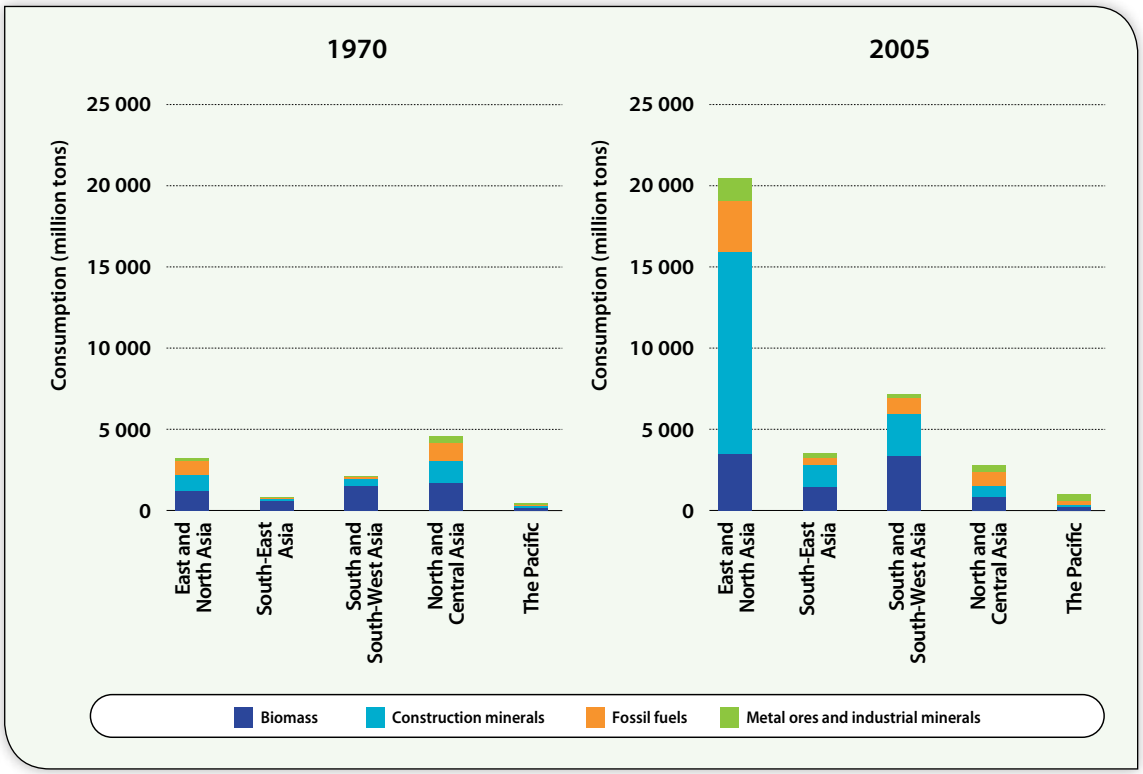
Figure 2.4 shows that different subregions are at different stages with regard to the "mineralization" of their economies. Biomass was the slowest growing component in all subregions between 1970 and 2005 and was closely related to population growth. Biomass use does not appear to depend on the level of economic growth. Mineral materials and fossil fuels grew fastest, especially in East and North-East Asia, and show an elasticity of about one; that is, they

Table 2.3: Share of domestic material consumption, 1970, 1990 and 2005

	Consumption, million tons and percentage					
	1970		1990		2005	
China	1 622	14.6%	5 693	27.1%	17 855	50.6%
India	1 331	12.0%	2 622	12.5%	4 403	12.5%
Union of Soviet Socialist Republics	4 552	41.1%	6 086	29.0%	-	-
Russian Federation	-	-	-	-	2 154	6.1%
Japan	1 364	12.3%	1 729	8.2%	1 468	4.2%
Indonesia	296	2.7%	594	2.8%	1 180	3.3%
Australia	299	2.7%	622	3.0%	913	2.6%
Turkey	253	2.3%	592	2.8%	865	2.5%
Thailand	126	1.1%	465	2.2%	749	2.1%
Pakistan	199	1.8%	428	2.0%	679	1.9%
Other APAC	1 043	9.4%	2 169	10.3%	7 176	20.3%
APAC	11 086		21 001		35 289	

Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.
APAC: Asian and Pacific countries.
*Presented in descending order of 2005 values.

Figure 2.4: Domestic material consumption by main material categories, 1970 and 2005

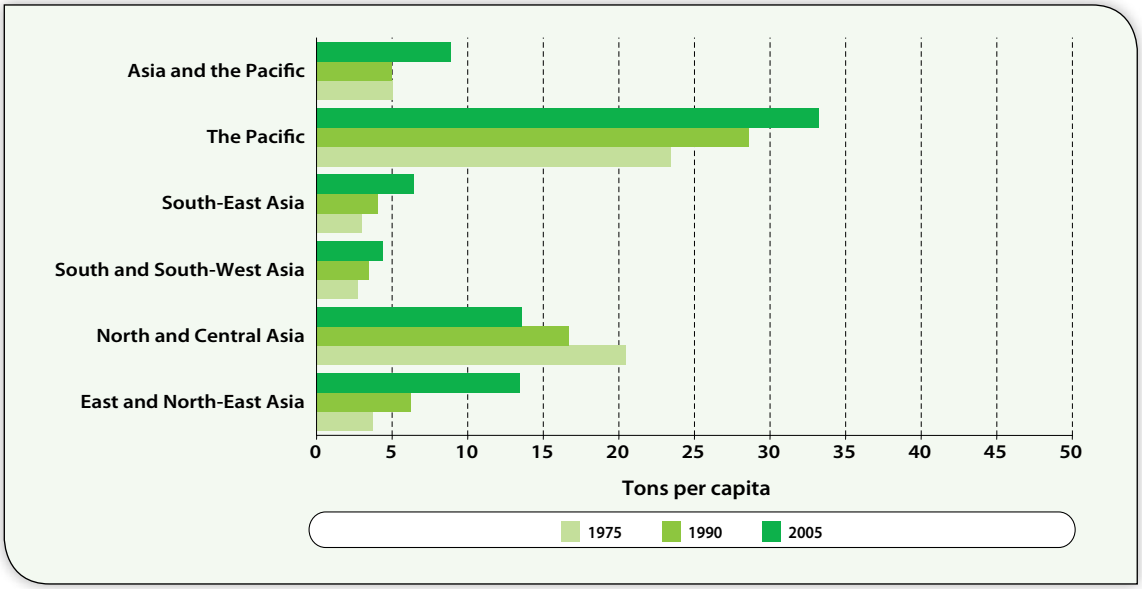


Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

are scaled with economic growth in almost the same proportions.

There are also stark differences in per capita domestic material consumption (DMC) among subregions, as shown by Figure 2.5. In 2005, consumption in the Pacific subregion, dominated by Australia's materials use pattern at around 34 tons per capita, was three times higher than the next largest subregion (East and North-East Asia) at about 13 tons per capita. The comparably low levels of DMC in South-East Asia and South and South-West Asia suggest that future growth in materials consumption may be significant when these subregions further industrialize and become more affluent. Such a pattern was

Figure 2.5: Domestic material consumption in the Asian and Pacific region and its subregions, 1975, 1990 and 2005



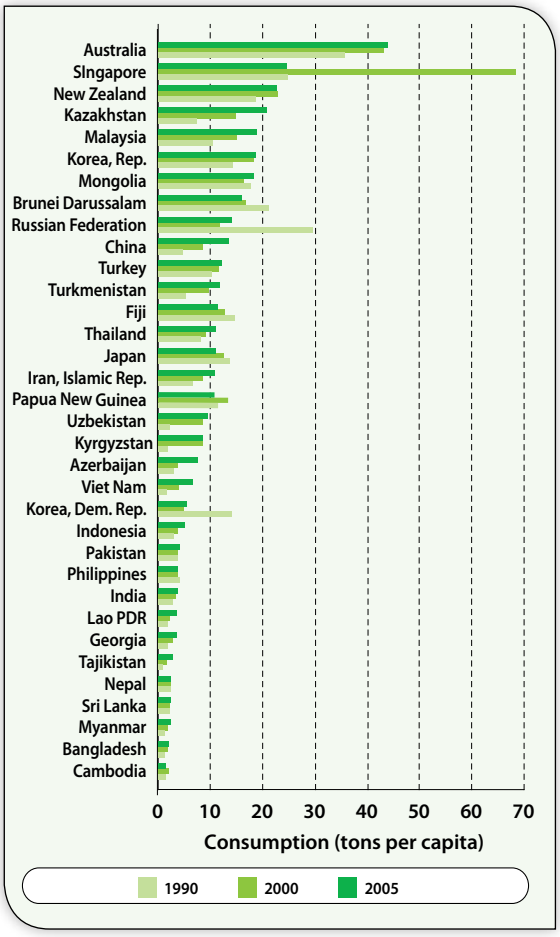
Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

witnessed in East and North-East Asia, which showed the largest increase in DMC of all regions from 1990 to 2005.

Figure 2.6 shows a comparison of per capita DMC for individual countries, confirming many of the subregional trends but also showing where countries divert from subregional patterns. Australia has the largest per capita DMC of all countries in Asia and the Pacific. A few countries have experienced a decline in per capita DMC, such as the Russian Federation because of economic restructuring, and Japan through resource-use policies and a high volume of imports.

Some developing countries have remarkably low per capita DMC, signaling future growth as they develop. In particular, energy use in many economies in Asia and the Pacific is still comparably low, translating into low labour productivity and low per capita GDP. Also, the energy that is used is not always allocated most efficiently across sectors. Future growth in energy use is to be expected as countries continue to urbanize, to establish modern infrastructure and transport systems, and electrify their communities. Building new manufacturing industries will further increase the demand for energy. This may translate into a relatively fast-growing energy demand of 2.4 per cent/year between 2005 and 2030, well above the world average of 1.5 per cent.[15]

Figure 2.6: Domestic material consumption in Asian and Pacific countries, 1990, 2000 and 2005



Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

Extraction and importation of materials

The fast-growing rates of domestic material consumption and energy use are linked to increasing domestic material extraction supporting the industrialization and urbanization of many countries, especially to build essential infrastructure.

The Pacific shows the largest per capita domestic extraction of materials followed by North and Central Asia (Figure 2.7). Many countries in both subregions have large export-oriented primary industries (agriculture, forestry and mining) and produce agricultural crops, ores and fossil fuels for foreign markets.

Meanwhile, the region has become more embedded in global trade flows, driven by increasing globalization and trade liberalization. While per capita net import levels are still low, the total amount of resources sourced from outside the region is already very large and growing rapidly, making the region an important player in global resource markets.

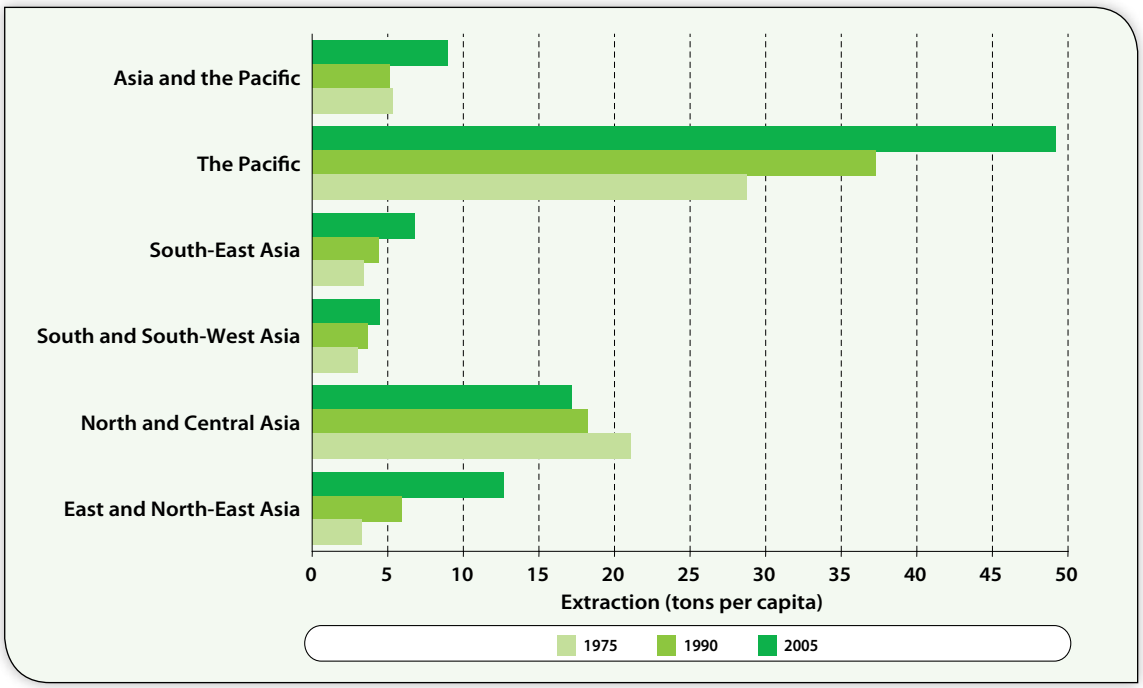
In particular, an increasing proportion of the fast-growing energy demand will be met by imports of crude oil. While North and Central Asia will continue to be a net exporter of fossil fuels, other subregions will increase their dependency on imports.[16]

Increasing dependency on imports of fuel, and also other resources, is likely to occur not only in the most populous economies, but also in those that are resource-poor and require tremendous resources to meet even current requirements. In particular, East and North-East Asia, an economically diverse and dynamic but resource-constrained subregion, has been increasing its imports of resources to satisfy its growing rate of material consumption (Figure 2.8).

South-East Asia, and South and South-West Asia, subregions with high poverty rates and low per capita access to resources, have physical trade balances that are also increasing - signaling increasing reliance on imports. South and South West Asia is already a net importer of materials.

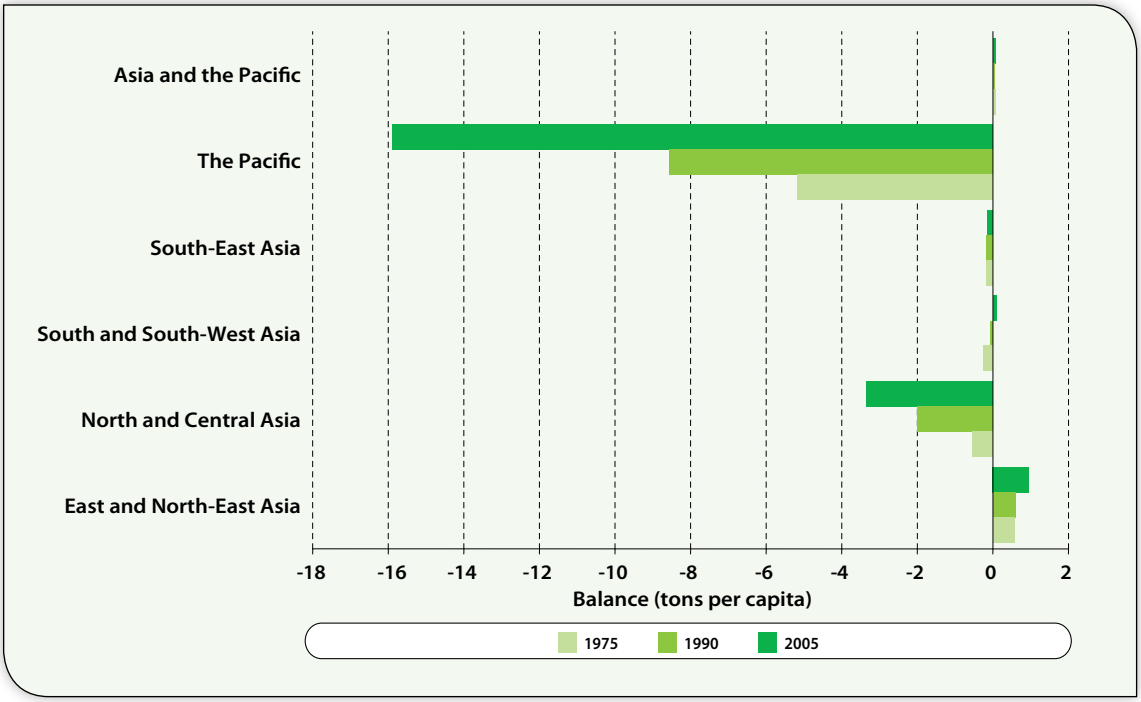
Many factors influence whether a country is a net exporter or importer of resources, including development status (industrialized, developing) and extent of resource endowments. Industrialized, low population-density economies (for example, Australia, Kazakhstan and New Zealand) usually have high DMC and export natural resources, whereas industrialized high population-density economies (Japan, Republic

Figure 2.7: Domestic extraction of primary materials in the Asian and Pacific region and its subregions, 1975, 1990 and 2005



Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

Figure 2.8: Physical trade balance for the Asian and Pacific region and its subregions, 1975, 1990 and 2005



Note: Physical trade balance equals imports minus exports
Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

of Korea and Singapore) have much lower DMC and import many of their natural resources.

Trends in industrialized countries suggest that, as developing countries further develop, those with high population densities (commonly a proxy for low resource endowments), such as India, will become net importers of resources, while those with low-population densities (for example, the Lao People's Democratic Republic and Mongolia) will be under increasing pressure to export their natural resources.[17]

The high demand from Asia and the Pacific will eventually be reflected in rising prices for fossil fuels, ores and food, adding pressure to national and household budgets. A continuation of these trends would increase the exposure to risks associated with relying on external suppliers to provide sufficient quantities of raw materials. Any disruptions in supply (whether economically or politically motivated) could seriously constrain the ability of the region and its countries to continue the strong economic growth trajectories that currently characterize the region.

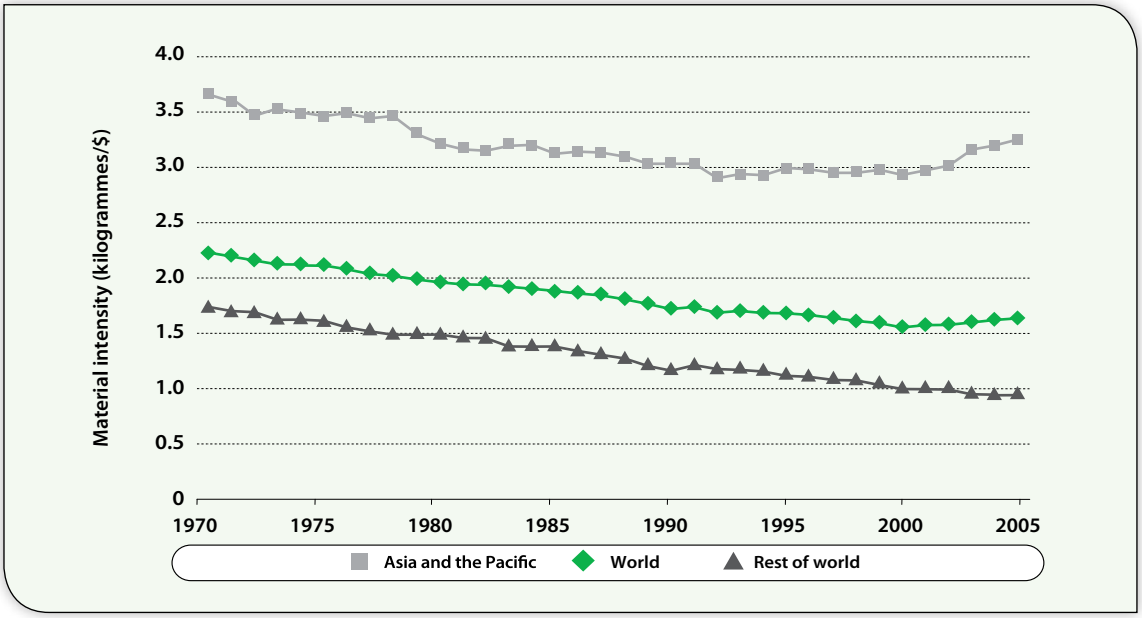
Countries that are net importers of materials will need to take specific steps to reduce their exposure to resource supply risk and to ensure that the use of resources translates as efficiently as possible into positive socio-economic progress and human welfare gains. In such circumstances, eco-efficient growth is critical.

There are also drawbacks for an economy to be concentrated into extractive economic sectors for export purposes as this may create pressure for the currency to appreciate (when the prices of the materials are high), thus reducing the competitiveness of other export sectors.[18] These economies face the challenge of reducing their dependence on extractive non-renewable resources for export, and need to ensure that economic gains from these resources are invested in creating a sound basis for future growth.

Resource efficiency trends

It is a characteristic of economic systems to improve resource intensity over time. Global resource intensity improved throughout the twentieth century.[19] Figure 2.9 illustrates this trend for the three decades from 1970 to 2000. This growth in efficiency (that is, a decline in the material intensity of production) appears to have been a worldwide phenomenon and continued until about 1991, when improvements in material intensity continued for the rest of the world but stagnated in the Asian and Pacific region until 2000.

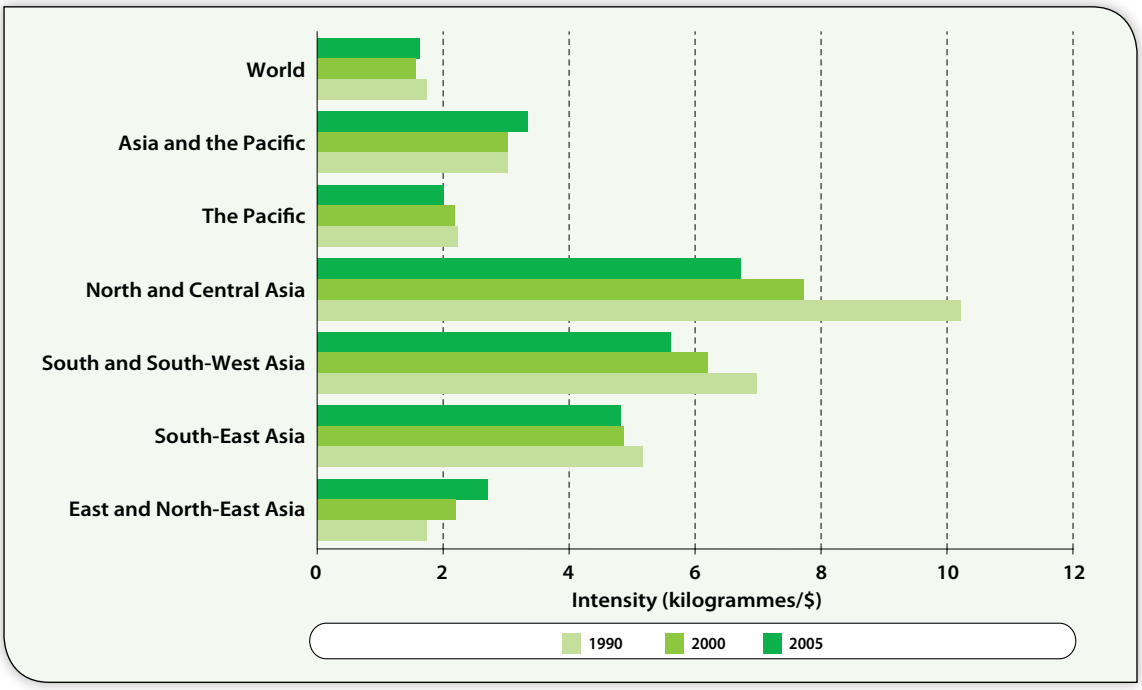
Figure 2.9: Material intensity for Asia and the Pacific, rest of world and world, 1970–2005



Material intensity is expressed as DMC/GDP (exchange values, 2000 prices).

However, reversing previous trends, from 2000 to (at least) the end of the analysis in 2005, material intensity in Asia and the Pacific increased rapidly, while the relative size of the region's economies was sufficient to change the moderate decrease in material intensity for the rest of the world into a moderate increase for the world as a whole. For the first time in a century, the world was using natural resources less efficiently, mainly because

Figure 2.10: Material intensity, domestic material consumption per GDP in Asia and the Pacific, its subregions and the world, 1990, 2000 and 2005



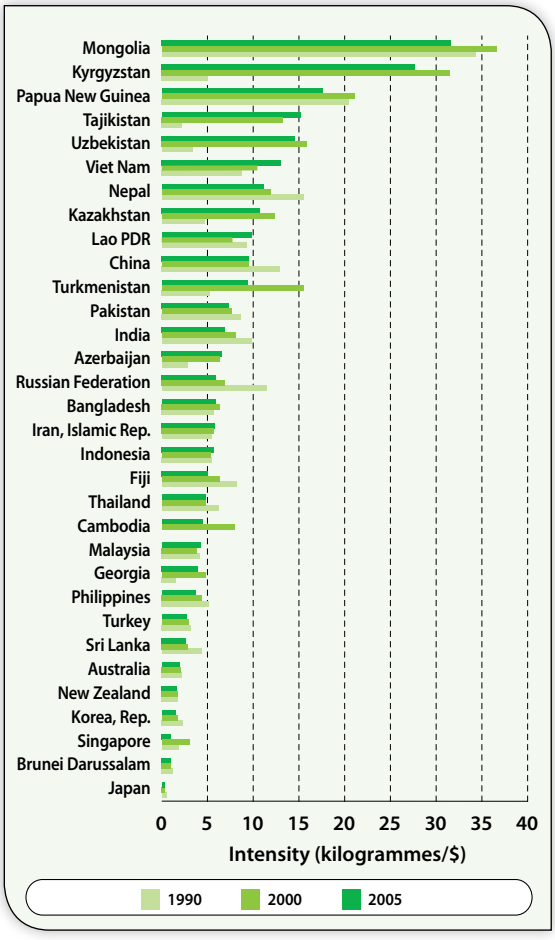
Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.
Material intensity is expressed as DMC/GDP (exchange values, 2000 prices).

resource use is growing faster than economic activity in the Asian and Pacific region.

Figures for energy intensity show that, throughout the last four decades, Asian and Pacific economies have always been twice as energy-intensive as the rest of the world. In 1970, Asia and the Pacific used around 25 megajoules (MJ)/$ produced, but improved steadily to 18.4 MJ/$ in 2001. Since then, overall regional energy intensity has stagnated and then grown, and is now at around 19 MJ/$. For comparison, the rest of the world moved from 15.7 MJ/$ in 1970 to 10.8 MJ/$ in 2005.

The apparent paradox in these overall regional trends is that most subregions and countries in the region are actually becoming more resource efficient, as shown in Figures 2.10 and 2.11.

Figure 2.11: Material intensity in Asian and Pacific countries, 1990, 2000 and 2005



Source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010. Material intensity is expressed as DMC/GDP (exchange values, 2000 prices).

In presenting country-specific data, it should be noted that industrialized, high population-density economies are able to externalize many of their resource-intensive primary processes, so that other countries typically bear the externalities of their relatively higher resource-efficiency levels. In that regard, higher levels of resource efficiency in these countries are somewhat misleading. The opposite is the case for resource exporters. There is an emerging body of literature on how material, energy and carbon emissions for nations would look different if a consumption perspective, including embodied resource flows, were taken into account.[20]

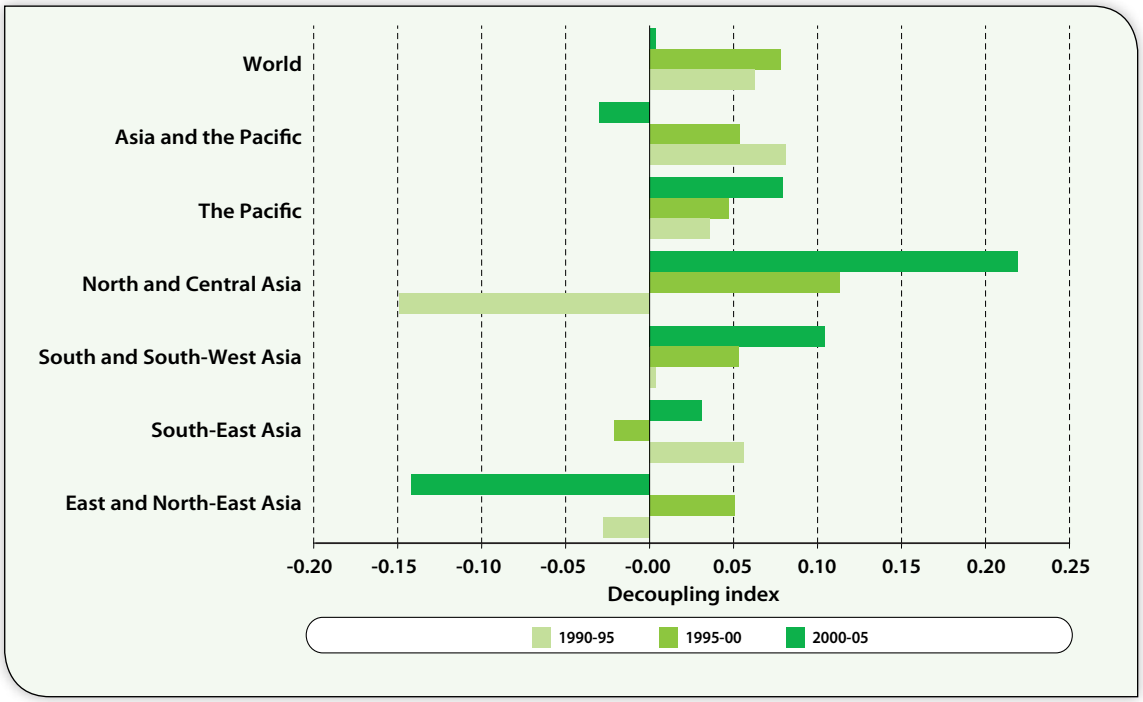
Decoupling trends

The decoupling factor reports on the extent of decoupling by relating the rate of GDP growth to the rate of change in resource use (Figure 2.12). For economic growth to be decoupled from resource use and to be environmentally sustainable, the amount of resources used to produce one unit of GDP—that is, "resource intensity" (used here as a measure of the efficiency with which resources in general, or specific resources, such as energy, water and materials, are used)—must decline over time. If this measure is increasing over time, the economy is growing along a less material-efficient path and could become more vulnerable to resource risks in the future (Box 2.3).[21]

During 1995-2000, there were improvements in relative decoupling, meaning that improvements in material and energy use outpaced the rate of GDP growth (but not at a fast enough rate to reduce overall resource use). This may have been enabled by a slowdown in resource use during the Asian financial crisis. Since 2000, there has been a huge rebound in resource use, reversing the decoupling achievements of the previous years and introducing a very resource-intensive transition driven by the economic success of such countries as China and India and countries in South-East Asia.

If these trends continue in the region, extractive pressures on the environment will increase even faster than the rapid rates of economic growth that have characterized the region in recent decades. As a result, since trends for the world are now heavily influenced by trends for the Asian and Pacific region, the material and energy intensities for the world as a whole will experience a steady upward trend, even if countries outside the region become more resource efficient.

Figure 2.12: Decoupling index for energy for the Asian and Pacific region, its subregions and the world, 1990 – 2005



Box 2.3: Decoupling

"Decoupling" describes the de-linking of two variables over time; for example, economic benefits and environmental pressures. Decoupling analysis provides information about how quickly (and in what direction) an environmental pressure variable (for example, resource use, emissions) changes as a driving force variable (for example, gross domestic product [GDP], population) changes over a given period of time. Decoupling is said to occur when the growth rate of environmental pressure is less than that of its driving force (for example, reduction in energy-use intensity over time).

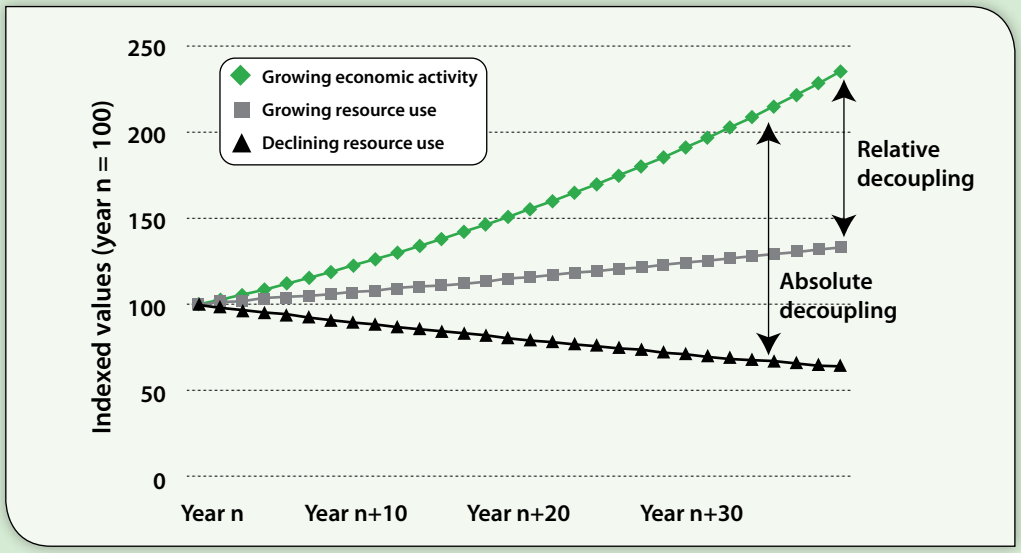
Relative decoupling occurs when the use of materials, energy or the emission of greenhouse gases grows slower than GDP, resulting in higher efficiency of resource use. Absolute decoupling occurs when resource use stabilizes or declines while the economy and employment grow. This report follows the Organisation for Economic Co-operation and Development (OECD) approach to measure the extent of decoupling by using a simple decoupling factor:

$$\text{Decoupling factor (period 0-t)} = 1 - \frac{\textit{resource use (t)/resource use (0)}}{\textit{output(t)/output(0)}}$$

When the change in the intensity of resource use and the changes in economic growth are explored, a positive decoupling factor indicates that the intensity of use of the resource by an economy is decreasing as GDP grows, indicating a less resource intensive growth path, and so more likely to be sustainable. Decoupling occurs when the decoupling factor is between 0 and 1 (where 1 equals maximum decoupling). Negative values indicate re-coupling between resource use and economic activity.

continued on next page.

Relative and absolute decoupling of economic activity and resource use



Source: Organisation for Economic Co-operation and Development, *Indicators to measure decoupling of environmental pressure from economic growth*, accessed from http://www.oecd.org/dataoecd/0/52/1933638.pdf on 30 June 2010.

Shifts in production amid insufficient technological progress, rising consumption and growth

The paradox raised above—that overall regional trends for material and energy efficiency are worsening, while most subregions and countries in the region are becoming more material and energy efficient—can be largely explained by the fact that economic activity is shifting away from efficient centres of production, such as Japan, to relatively more resource-intensive centres of production, such as China. In 1970, Japan accounted for 75 per cent of all economic activity in the Asian and Pacific region, while China contributed only 4 per cent. Resource efficiency in Japan was 0.75 kg/$ compared with 16 kg/$ in China. By 2005, China had increased its economic contribution to 20 per cent at a resource efficiency of 9.5 kg/$. Japan, over the same period, had decreased to 50 per cent at an efficiency of less than 0.5 kg/$.

The enormity of this shift has been enough to affect regional efficiency trends. In China (and to a lesser extent in South and South-East Asia), growth has been characterized by massive infrastructure development, rapid urbanization, enhanced transport capacity and the establishment of energy production and electricity infrastructure. New consumption and mobility patterns are also seen among higher-income urban households. Such factors have overwhelmed improvements in resource efficiency.

The changing regional contributions to production and consumption activity are only part of the story. The three key drivers of increasing material consumption are population growth, rising incomes, and resource efficiency (the resources used to produce one unit of GDP, as a proxy for all factors other than population and income, such as structural change and technology).

An analysis of these factors (Box 2.4) shows that growing populations and incomes have both been important drivers of increases in resource use, but the impact of rising incomes has grown over time. While improvements in resource efficiency (that is, reductions in the material used to produce one unit of GDP) helped to offset some of the growth in material consumption between 1975 and 1985, this situation was reversed from 1995 to 2005. During this period, all three drivers—population, affluence or incomes, and resource efficiency trends worked to increase domestic material consumption.

The importance of population growth is likely to decrease as a slowdown in population growth

rates in the region takes place; however, economic growth and material intensity changes have been much more pronounced in Asia and the Pacific than in the rest of the world, resulting in faster growth in per capita resource use in the region than elsewhere.

Expansion of construction, manufacturing, transport and food production, and changing production and consumption patterns have accelerated the transformation of materials, especially in East and North-East Asia. Large investments in infrastructure are part of this changing picture. It may well be that when the growth in demand for raw materials in these fast growing countries, such as China, eventually stabilizes, the growth in demand in other economies of the region will accelerate. India is an interesting case, with very low current levels of per capita material and energy use but huge potential for growth in coming decades.

Outlook

The UNEP Resource Efficiency: Economics and Outlook for Asia and the Pacific (REEO) report has developed two novel models of the economy and resource use in Asia and the Pacific.[22] The two models, a dynamic non-equilibrium economic model and a technology-based physical model, have been linked to simulate a future resource use and economic outlook for 2010-2050.

Three different scenarios were established to show how material and energy use, along with emissions, might develop under different policy contexts:

- business as usual scenario, which assumes marginal improvement in resource efficiency;[23]
- resource efficiency scenario that implements large-scale efficiency in material and energy use across all sectors;

Box 2.4: Analysing change

The level of resource use in a region is driven by a multitude of factors, including geography, climate, resource endowment, economic structure and development status. To understand better how resource use in Asia and the Pacific has developed up to the present, and what trajectory it might take into the future, it can be helpful to identify and analyse key drivers independently. One widely used analytical framework to achieve this is the IPAT equation:

I = P * A * T

This equation in its original form proposed by Ehrlich and Holdren[a] conceptualizes the total impacts on the environment (I) as the product of population (P), the level of affluence of the population (A), and a technological coefficient (T). In this analysis, "I" is defined as the extractive pressure on the environment, using domestic material consumption (DMC) as the indicator. "A" is taken to be gross domestic product (GDP) per capita. T is defined simply as the resources used per unit of GDP generated (DMC/GDP), that is, materials intensity. Changes in T do not necessarily or directly indicate that a society's technology is becoming more or less advanced, it only indicates the change in the relationship between materials used (DMC) and the economic output (GDP), which is governed to a large extent by the technologies used both in production and consumption, but also influenced by other factors, such as structural change and infrastructure development.

The table below shows changes in DMC over three decades from 1975 to 2005, and the respective roles of population growth, per capita GDP, and material intensity in driving that change. Overall DMC grew by 4.3 billion tons during 1975-1985 and 11.6 billion tons during 1995-2005. Growing population and incomes have both been important drivers of domestic material consumption, but the influence of rising incomes has increased over time.

While improvements in material intensity helped to offset some of the growth in DMC during 1975-1985 (as indicated by the negative values for T), this situation reversed during 1995-2005, with all three drivers (population changes, income changes and material intensity changes) acting to increase DMC. In East and North-East Asia in particular, technologies in construction, manufacturing, and transport and food production were modernized as both production and consumption patterns changed, resulting in accelerated consumption of materials.

continued on next page.

DMC and driving forces in the Asian and Pacific region, 1975-2005

Subregion	Contributing drivers: Individual contribution to change in DMC (%)[b] P = Population	A = GDP / Pop.	T = DMC/ GDP	Change in DMC[c] (%)	Change in DMC (million tons)
1975-1985					
East and North-East Asia	14.1	33.3	6.1	61	2 486
North and Central Asia	10.5	22.8	-18.8	10	528
South and South-West Asia	25.8	12.5	-1.3	40	980
South-East Asia	23.4	49.2	-26.7	35	345
The Pacific	14.7	13.0	-14.5	11	53
Asia and the Pacific	**18.9**	**25.1**	**-10.4**	**33**	**4 392**
1985-1995					
East and North-East Asia	13.5	33.9	26.5	92	6 030
North and Central Asia	-22.7	-47.3	8.7	-56	-3 197
South and South-West Asia	21.6	29.2	-6.6	47	1 610
South-East Asia	20.7	69.9	-6.9	91	1 212
The Pacific	17.4	14.5	15.2	55	298
Asia and the Pacific	**14.0**	**22.9**	**-4.5**	**34**	**5 953**
1995-2005					
East and North-East Asia	7.6	23.6	21.8	62	7 793
North and Central Asia	-0.2	50.1	-22.3	16	417
South and South-West Asia	18.7	42.4	-16.0	42	2 123
South-East Asia	15.5	26.1	-3.0	41	1 050
The Pacific	15.5	23.6	-9.8	29	243
Asia and the Pacific	**12.5**	**23.0**	**7.9**	**49**	**11 626**

Data source: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010; World Bank, *World Development Indicators* (Washington, D.C., 2009), accessed from http://data.worldbank.org/data-catalog/world-development-indicators on 12 July 2010.

[a] P. R. Ehrlich and J. P. Holdren, "Impact of Population Growth", Science (1971), vol. 171, No. 3977, pp. 1212–1217.

[b] Loss of population and income in North and Central Asia are driven by the restructuring of the former Soviet Union and the loss of some of the successor States from the Asian and Pacific region (for example, Ukraine), as well as the de-industrialization that followed the economic restructuring.

[c] The individual percentage changes in each driver will generally not sum to the total change in DMC. This is due to the multiplicative nature of the IPAT equation. If for example P, A, and T were all to increase by 20 per cent over a period, the total change in I would not be 60 per cent, but 73 per cent.

DMC: domestic material consumption, GDP: gross domestic product.

- systems innovation scenario that assumes a transition to new industrial infrastructure for commercial and residential buildings, mobility, energy, water and food production, combined with the resulting lifestyle changes.

The REEO modelling (see Table 2.4) found that business as usual would lead to rapid growth in material and energy use and carbon dioxide (CO_2) emissions. By 2050, the region would consume 80 billion tons of materials and 700 exajoules

Table 2.4: Resource use, economy and employment outcomes of three alternative scenarios

		Business as usual	Resource efficiency	Systems innovation
Material use	2010-2030	↑	→	
	2030-2050	↑	↗	↘
Energy use	2010-2030	↑	→	
	2030-2050	↑	↗	↘
CO_2 emissions	2010-2030	↑	→	
	2030-2050	↑	↗	↘
Waste	2010-2030	↑	→	
	2030-2050	↑	↗	↘
GDP	2010-2030	↗	↗	↘
	2030-2050	↗	↗	→
Unemployment	2010-2030	→	↗	↗
	2030-2050	→	→	→

Source: United Nations Environment Programme. *Resource Efficiency: Economics and Outlook for Asia and the Pacific* (Canberra, CSIRO Publishing, 2011).

CO_2 = carbon dioxide, GDP = gross domestic product.

(EJ) of energy/year, and CO_2 emissions would triple. These are amounts that would most likely challenge the capacity of the Earth's resources and ecosystems.

Making use of all technological potential within existing systems, as indicated by the resource efficiency scenario, will not significantly reduce the impact on resources and the environment in the long run. Use of materials and energy, and emissions of CO_2, would stabilize for about two decades before resuming growth to reach about double 2010 levels by 2050. Potential efficiency gains will not keep pace with a growing population, and growing per capita incomes and consumption rates. This scenario shows that resource efficiency is a necessary prerequisite for reducing the global environmental impact of rapid development and modernization in Asia and the Pacific, but used in isolation, it will not be sufficient to bring about sustainability.

In the systems innovation scenario, high resource efficiency is complemented by a large structural change in how consumption and production are organized. Such a change would affect the way in which people are housed, how they get around and how water, energy and food are produced. These changes would be enabled by huge changes in urban and infrastructure planning and investment and would include sufficiency strategies for high-income households.

The structural change assumed in the systems innovation scenario, coupled with high resource use efficiency, may eventually lead to sustainability, but requires substantial changes in policies, economic behaviour and societal aspirations. This suggests that it will require a second industrial revolution to establish the well-being of people and nations on a fundamentally different economic basis. New industrial infrastructure needs to be developed that requires less materials and energy and allows for higher flexibility and lower risks in the face of global environmental change and resource scarcity.

There are also differences in economic and employment outcomes under the three scenarios, where growth appears to be stronger in the business as usual and resource efficiency scenario and employment stronger in the business as usual scenario. Systems innovation and resource efficiency assumes new economic activities in renewable energy, housing and mobility as well as service sector activities that would support these new activities. Because models somehow tend to the status quo, these new activities and sectors (as well as their economic and employment outcomes) may be underestimated, and the difference between scenarios until 2050 may be negligible in that regard.

Such modelling, backed by solid data, may well support governments in exploring the impact of their decisions on the demand for resources and in formulating appropriate responses. It will be important to look both at the quantity and quality of resources used throughout the value chain. The objective should be inclusive socio-economic progress that translates into tangible

benefits for people. As discussed in Box 2.5, there may be opportunities to improve human development without substantial increases in material or energy use.

To this end, a sound understanding of the relationship between energy use, economic growth, material productivity and employment, and more explicit attention to investment in human capital are required. For a more sustainable and inclusive result, cooperation on trade and investment issues will also be required, as the primary drivers of resource use and the shifting of resource burdens.

Conclusions

For governments throughout the region, resource risks are growing. The global economy has passed from an era in which human-made capital was the limiting factor in economic development, to an era in which the remaining natural capital may well be the limiting factor. Resources acquired from other countries enabled the economic development of many OECD countries. In contrast, the opportunities of today's developing nations to utilize cheap resources from elsewhere are far more limited. Moving from an empty to a full world, as Herman Daly has put it, fundamentally changes the economics of all production and consumption activities.[24]

Important changes in trends have occurred since 2000. As highlighted by this chapter, material and energy intensities of the region are on the rise. As a consequence, growth in the consumption of primary materials has accelerated. The use of coal as an energy source, especially for electricity generation, has increased, and so have emissions of greenhouse gases. At the same time, local resource constraints are becoming more evident for energy carriers and certain strategic materials, resulting in increasing dependence on foreign resources. Further, the accelerated speed in resource utilization has not been translated into further progress in poverty reduction, which has slowed.

There is a window of opportunity for green growth and resource efficiency over the next 20 years, because the region is investing massively in infrastructure and productive capacity now. If investment in major systems of provision of basic services, including housing, mobility, and utilities (water and energy) were to be directed towards the fastest-growing and most resource-intensive countries and regions, this would have a lasting effect for the next half century. Such investment would improve resource efficiency and lower overall environmental impact. It would also increase equitable access to essential services for urban populations.

As this analysis has shown, many countries have been successful in reducing their material and energy intensity of production and consumption over time. However, reductions in resource intensity have not been enough to ease environmental pressure and impacts because of the massive restructuring from traditional to modern-industrial systems and related growth in resource use. For overall resource use to decline over time, resource intensities must decline as GDP increases. The outlook for future resource use is highly negative when resource intensities increase faster than GDP.[25]

As discussed in Chapter 3, the new public policy discourse on green growth, and the notion of decoupling economic growth from resource consumption (and related environmental impacts), have allowed governments to go beyond the growth critique of the 1970s[26] and the overconsumption debate of the 1990s[27] by avoiding questioning economic growth as such. It also presents a more inclusive approach that recognizes the legitimate aspirations of the developing world in particular, for improved material standards of living.

Resource use in many countries in Asia and the Pacific will continue to grow, especially as populations continue to expand and human aspirations and needs are not yet satisfied to a standard achieved in other parts of the world. The notion of decoupling underlines the importance of simultaneously considering different objectives, including social, economic and environmental goals.

The objective, put simply, is socio-economic development while minimizing wasteful management of precious natural resources due to ineffective and inefficient use. This must be done in a way that avoids shifting environmental burdens between regions. A sound understanding of the relationship between energy use, economic growth material productivity and employment, and more explicit attention to investment in human capital are required.

Beyond meeting basic needs, the view that consumption and constantly increasing incomes

Box 2.5: Resource use and human development

The Asian and Pacific region faces the challenge of ensuring that economic growth translates into tangible benefits for people. The severity of the sustainability challenge varies across countries. Some countries use resources more efficiently and some are better endowed with resources. Some have reached high levels of economic development and human well-being, while others have not.

The degree to which socio-economic progress and human development require large quantities of material and energy consumption is a key issue. In this brief analysis, this is addressed in a simple way by examining how human development—as measured by the Human Development Index (HDI)[a]—correlates with material use (as measured by per capita domestic material consumption) and energy use (as measured by kilogrammes of oil equivalent [kgoe] per capita).

At the outset, it is important to note that it is not assumed that a simple binary causal relationship between human development and per capita material consumption or energy use exists; many factors affect human well-being on a national scale, such as resource endowments, economic development strategies, infrastructure, governance, markets, technologies and investment in human and natural capital. The results are presented in the two figures below. Notwithstanding the above caveat, the data suggest some overarching conclusions that may be worth further detailed investigation.

First, across the entire spectrum of human development, higher levels of HDI are associated with higher levels of per capita material consumption and energy use. None of the selected countries shown in the figures have achieved HDI levels beyond the identified threshold for high human development with an annual per capita domestic material consumption of less than 10 tons, and energy use of less than 1,000 kgoe.

Second, both figures show that at low levels of HDI, large increases in HDI can be achieved with relatively modest increases in per capita material consumption and energy use. This suggests that countries at the lowest levels of socio-economic achievement gain relatively more incremental benefit (as measured by increases in HDI) from each added unit of resource use than those countries at higher levels of HDI. A recent study suggests that an additional 400 kgoe per capita in energy-poor countries could support doubling HDI level for those countries that have not crossed the medium-high HDI threshold (0.5).[b]

Third, at high levels of HDI, especially at those levels beyond the identified threshold for high human development, modest additional gains in HDI are generally associated with significant increases in per capita material consumption and energy use. This and the above conclusion suggest that diminishing returns occur in material consumption and energy use in the production of human development and well-being, as measured by the HDI.

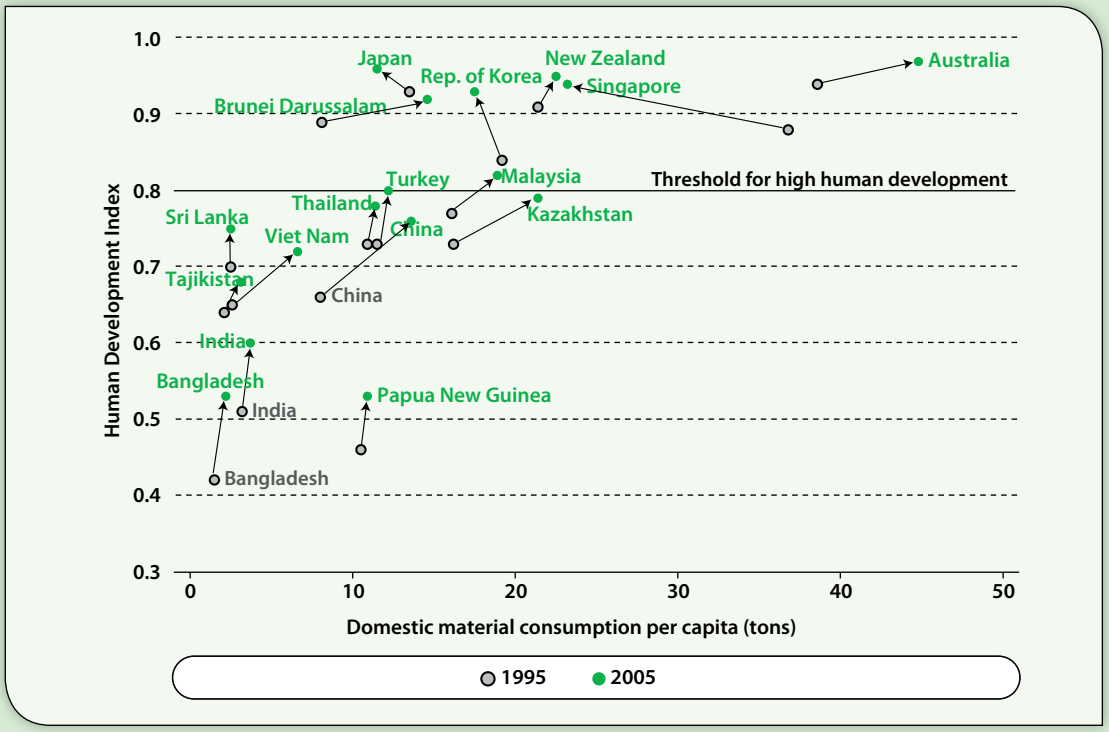
Fourth, both figures indicate that high levels of human development may be achieved at substantially different levels of domestic material consumption. Notwithstanding the simplicity of the correlation examined here, this suggests that countries can substantially decouple material consumption and energy use from human development by means of appropriate policies, incentives, and investments.

Finally, note that Japan, Republic of Korea and Singapore have achieved higher levels of HDI with reduced per capita material consumption. Although Singapore's socio-economic progress between 1995 and 2005 was achieved while reducing domestic per capita material consumption by almost one third, this reduction came after significant infrastructure investments in the 1980s and early 1990s, which may explain the relatively high level of per capita material consumption in 1995. In the case of Republic of Korea and Singapore, these gains in HDI were achieved with large increases in energy use per capita.

[a] The HDI provides a measure of development by combining into a single index indicators of life expectancy, educational attainment and income. The HDI sets a minimum and a maximum for each component of the index (called goalposts) and then shows where each country stands in relation to these goalposts, expressed as a value between 0 and 1.

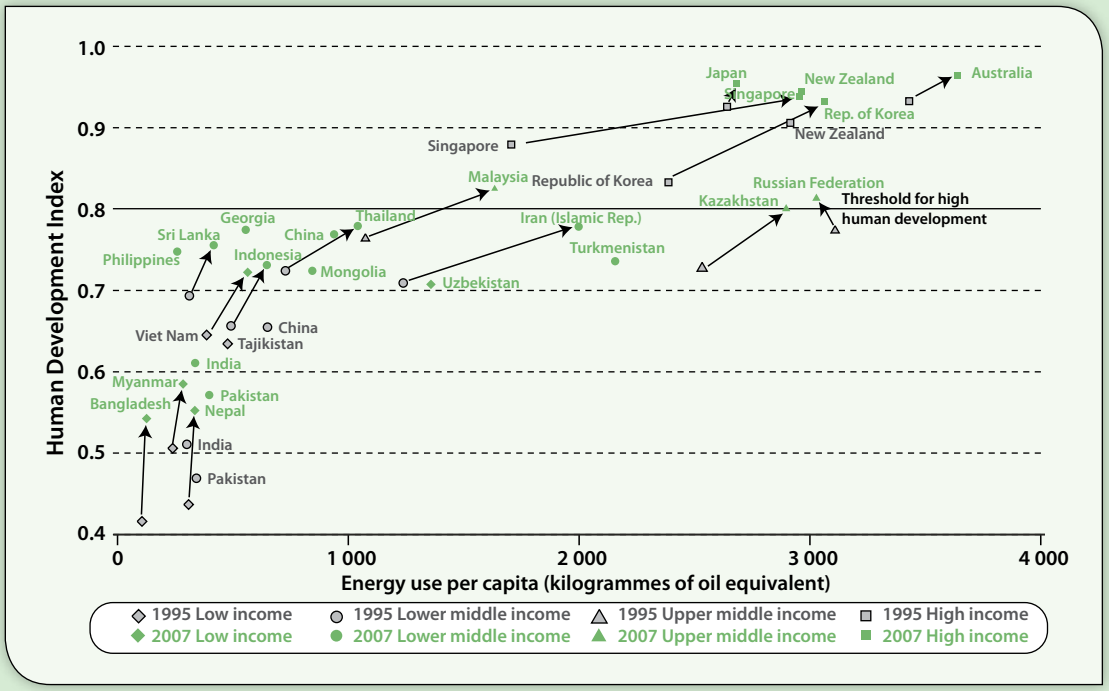
[b] D. Martinez and B. Ebenhack, "Understanding the role of energy consumption in human development through the use of saturation phenomenon", *Energy Policy* (2008), vol. 36, pp. 1430–1435.

HDI and domestic material consumption per capita, 1995 and 2005



Source: Human Development Index: United Nations Development Programme (UNDP), *Human Development Report 2009*, accessed from http://hdr.undp.org/en/reports/global/hdr2009/ on 10 July 2010. Energy use per capita; based on data from International Energy Agency and World population prospects: The 2008 revision population database, accessed from http://esa.un.org/unpp on 7 June 2010.

HDI and energy use per capita, 1995 and 2007



Source: Human Development Index: United Nations Development Programme (UNDP), Human Development Report 2009; Domestic consumption per capita: CSIRO and UNEP Asia-Pacific Material Flow Database, accessed from www.csiro.au/AsiaPacificMaterialFlows on 11 July 2010.

have a dominant role to play in delivering human well-being is also being questioned. The notion that equitable access to resources is an important goal is highlighted by the material flows data presented in this chapter, which show that an average person in South and South-West Asia, where a large percentage of the region's people live, uses less than half of the resources used by the average global or regional citizen. Similar differences exist within countries, and gaps between the richest and the poorest are reportedly widening.

Resource flow accounts and key indicators are a first step in informing regional initiatives and national governments about the history, current conditions and most likely future of resource use, but more needs to be done to prepare for the changing economics of resource use. Countries need to further develop institutional capacities, the knowledge base and data on natural resource use. Government departments, statistical offices and research institutes need to work together to address the future challenges of resource supply security and to deal with wastes and emissions. A well-developed knowledge base and information systems may eventually guide policy plans and programmes and may yield a triple dividend of enhanced competitiveness, greater well-being and sound environmental and resource use.

CHAPTER 3: GREENING GROWTH: TOWARDS A GREEN ECONOMY

Introduction

Chapter 1 describes a changing policy landscape defined by increasingly evident resource constraints and continuing economic and environmental risk and uncertainty. Together with persistent inequality and poverty, these challenges are already affecting those most vulnerable in society, while progress on reducing poverty and hunger has slowed. With the resilience of many economies and societies already eroded by financial crises, the ability of governments to secure future stability and prosperity is in question.

In the Asian and Pacific region, these challenges are magnified by rapid and sustained economic growth based on high resource intensity, along with growing resource constraints and an increasing dependence on imported resources. Meanwhile, the phenomenon of jobless growth in some of the region's most dynamic economies reflects growth and investment patterns that have hampered the region's progress towards sustainable development. The notion that both human and natural resources are in plentiful supply has reduced incentives to invest in human capital and improve resource efficiency. While continued economic growth remains necessary to reduce poverty and increase resilience, a greater focus is needed on achieving more equitable growth.

Several countries in the region, including both large and small developing countries and leading economies, have recently established important policy initiatives, as shown by the list of selected country initiatives presented in Chapter 1. These initiatives provide an important body of experience that hints at the potential for fundamental economic transformations needed to secure a sustainable future.

Green growth, as agreed at the fifth Ministerial Conference on Environment and Development in Asia and the Pacific, is a strategy for achieving sustainable development. It is focused on overhauling the economy in a way that synergises economic growth and environmental protection, building a green economy in which investments in resource savings as well as sustainable management of natural capital are drivers of growth. An economy which is in closer alignment with sustainable development objectives provides opportunities for using financial resources better to meet development needs and reducing the vulnerability of socio-economic systems to environmental change and resource constraints.

Overhauling the economy

A more realistic response

It is increasingly evident that fuelling growth through an endless and cheap supply of natural resources is no longer possible. High food, energy and commodity prices continue to dim the socio-economic outlook and dominate the policy agendas of major economies of the region.

Steps taken after the 1997 financial crisis in Asia and the Pacific and elsewhere since 2008 have helped to mitigate some of the risks that triggered the financial crisis. However, a meaningful response to the implications of resource constraints for people and economies is still nascent in most countries. In this new economic reality, stimulating resource-intensive consumption

and production patterns as the main strategy for economic recovery may prove an unsuccessful long-term response, with disproportionately high negative impacts on developing country economies and societies.

Meanwhile, countries in the region are also motivated to sustain, or even accelerate, their present growth trajectories, requiring advances in trade, human capital, infrastructure and financial development. However, there are significant challenges to continued economic growth, such as significant rates of illiteracy and unemployment, massive unmet investment needs and underdeveloped financial sectors.

The promise of a green economy is a key aspect of the search for a better quality of growth. The United Nations Environment Programme (UNEP) estimates that an investment of 2 per cent of global gross domestic product (GDP) annually (or less than one tenth of the total global investment/year) into building a green economy could be enough to significantly change the economic outlook and risks related to resource scarcity and climate change within decades. In many developed economies, such an injection of re-directed capital and the requisite enabling conditions may already be within reach (Box 3.1).

In developing countries of Asia and the Pacific, the prescribed investments will require a significant change in the economic incentives and infrastructure (policy, institutions and built infrastructure) that influence the way that both natural and human capital are valued and used in the economy. Without such changes, investments on the scale needed to put economies on a green growth path are unlikely to take place.

There are tremendous opportunities presented by the unmet needs for basic services, such as water, energy and housing, in the fledgling markets and rapidly growing urban centres. There

Box 3.1: The potential for a green economy

Economic modelling done for the United Nations Environment Programme (UNEP) investigates the macro-economic impacts of investing 2 per cent of global gross domestic product (GDP) on an annual basis over the coming decades into business-as-usual and green economy scenarios. Under a green economy scenario, half of the investment is allocated to energy efficiency and the development of renewable energy sources. The remainder is devoted to improved waste management, public transport infrastructure and natural capital-based sectors, such as agriculture, fisheries, forestry and water supply.

The UNEP *Towards a Green Economy* report stresses that a green investment scenario delivers long-term growth over 2011 to 2050 while avoiding considerable downside risks, such as the effects of climate change, water scarcity and the loss of ecosystem services. While there will be both winners and losers, it concludes that returns on investments between 2011 and 2050, compared to business as usual, could include

- savings on capital and fuel costs in power generation of about $760 billion/year;
- increased value added in the forest industry of more than 20 per cent compared to business as usual, increased formal employment and increased carbon storage—from investing 0.03 per cent of GDP between 2011 and 2050 in paying forest landholders to conserve forests and in private investment;
- reduced demand for water by about one fifth, from annual investments of $100 billion to $300 billion in increased water efficiency in agriculture, industry and the municipal sector;
- transformation of agriculture from a major greenhouse gas (GHG) emitter to GHG neutrality or a possible carbon sink, while reducing deforestation and freshwater use by 55 per cent and 35 per cent, respectively, based on the adoption of sustainable farming methods.

UNEP's report concludes that key enabling conditions include establishing sound regulatory frameworks, prioritizing government investment and spending in areas that stimulate the greening of economic sectors, limiting spending in areas that deplete natural capital, employing taxes and market-based instruments to shift consumer preference and promote green investment and innovation, investing in capacity building and training and strengthening international governance.

Source: United Nations Environment Programme, *Towards a green economy: pathways to sustainable development and poverty eradication, a synthesis for policy makers* (Nairobi, 2011).

is significant potential for leapfrogging—avoiding the mistakes of a "grow now, clean up later" approach to economic growth—by deploying economic strategies that are better matched to a new economic reality and better able to meet evolving expectations and capacities.

Many strategies consistent with green growth, such as investing in public transport or improving water resources management, are not only sound environmental policies, but also sound development strategies. Developing countries can embark on them with no regrets. To this extent, a key question is not whether or not green growth is feasible in developing countries, but *how* can a green economy be built. Countries must determine the approaches, priorities and policies that fit their particular sustainable development challenges.

A virtuous cycle for green growth – systemic reform

Sustainable development will remain elusive while the environmental and social costs of economic growth are externalized and disproportionately borne by those who have least benefited. Price signals, which are reflective of policies, institutions, technologies, infrastructure and social preferences, must be more closely aligned to sustainable development objectives. Economic growth must be driven by investment flows that promote inclusive and sustainable development outcomes.

Even though there is upward pressure on the prices of energy and several kinds of commodities, green growth will not take place automatically without making fundamental economic transformations. In particular, there is a need to close two gaps: (a) the "time gap" between short-term costs and long-term benefits of investments that reduce environmental pressures; and (b) the "price gap" between market prices and the economic value of ecosystem goods and services, which reduces the incentives for resource savings or investment in natural capital.

Governments must take the lead in closing both gaps. While governments can inject stimulus financing, as done in the wake of the financial crisis, they cannot do so on a continuous basis. The goal is to ensure that once initiated by stimulus or innovative financing arrangements that help to close the time gap, the momentum towards a green economy is maintained by reducing the price gap to boost the economic viability of a green economy rather than a "brown" one.

The transition to green growth must be supported by and involve civil society. Positive attitudes towards sustainable lifestyles and consumption patterns are required. As multiple benefits are revealed, societal and private sector support for building a green economy will also become an important driver for accelerating green investments.

There are two key messages. First, a supportive economic incentives framework, or "invisible infrastructure" of the economy lies at the heart of successful green growth initiatives. "Recalibrating" prices of natural and human capital to truly reflect their economic values is critical to keeping the green growth engine running. If economic values of ecological goods and services are better reflected in markets and decision-making processes, the green growth engine will fuel itself, continually expanding investments in new green sectors and greening production and consumption in others. Unless the underlying economic forces and financing mechanisms are directed towards environmentally sustainable and socially inclusive investments over the long term, the momentum achieved towards green growth will be quickly lost—and any gains in environmental protection will be overwhelmed as economies grow.

The second key message is that sustainable development and management of the "physical infrastructure" of the economy—comprising both built and natural capital—are also required as a basis for achieving a better quality of growth, especially in developing countries in which infrastructure needs are still great and in which incentives for degrading natural capital are large.

An example of the power of the economic incentives framework is increasingly evident in the energy sector, where the potential of the green economy is arguably in greatest evidence. As discussed in Chapter 5, a transition to low-carbon energy technologies is in its initial stages. The increase of fossil fuel prices through market forces has helped "recalibrate" market prices so that investments in renewable energy have become more profitable.[1] While there is still a long way to go, carbon markets have also helped reduce the "price gap" between the market price of fossil fuel and the true economic cost of using fossil fuel. Simultaneously, fiscal stimulus packages

and other policy incentives (such as feed-in tariffs), and greater institutional support have also provided financing and reduced investment risks. All of these factors together have enlarged markets for clean energy technologies, spurred technological innovation and created new jobs.

The case of renewable energy highlights the possibility of acting in the absence of a complete internalization of externalities into market prices through complementary policy and institutional support. At the same time, renewable energy also provides an example of how market signals must be further changed to increase momentum. At present, only a few countries in the region have sufficient renewable resources to meet projected energy demand in the next two decades, and renewable energy is still more expensive than fossil fuels on an "installed cost" basis.

Defining specific integrative policy tools and strategies that bring demand-side and supply-side interventions together is now a critical aspect of the enabling environment for green growth, as discussed in the section on building an integrated policy framework below.

While green growth is a key strategy for achieving sustainable development, building a green economy has a long-term perspective and may produce better outcomes in terms of poverty reduction, as it can reduce the vulnerability of socio-economic systems to external shocks and crises and sustainably manage the natural resources that underpin the economy, as well as free resources to provide better access to basic services.

Green growth is not, however, a panacea. While the modelling for the UNEP *Towards a Green Economy* report shows that the benefits for economic growth will be most evident in the medium to long term, in the short term there will be both winners and losers. This requires specific policy responses and careful "transition management" by governments.[2] To enable widespread benefits and to capitalize on the potential of the green economy, the appropriate skills and knowledge base must be present; investment in human capital is a key requirement.

The potential of green growth to reduce poverty and improve the quality of life of all people will also depend on the elaboration of specific programmes, policies, financing and governance approaches, including institutional innovations to ensure that growth is not only green but also inclusive. This is underlined by International Energy Agency (IEA) projections that, even in a "new policies" scenario,[3] the problem of lack of access to modern energy services will persist in the long term—the numbers of people without electricity will remain high in 2030, and those using biomass for cooking will increase rather than decrease by that time.[4] Policies for greening economic growth cannot substitute for sound social policies and good governance, or directly address all the root causes of persistent poverty.

Priority actions

Priority actions identified in this section include a) reforming the economic incentives framework to close "price" and "time" gaps (as described above); b) promoting sustainable infrastructure development and c) facilitating investments in natural capital. These strategies have both short and long-term benefits and the foundations can be established in relatively short periods. For each country, strategies should be adapted to fit specific development priorities and gaps, as well as the environmental pressures faced by the country.

A longer-term view towards fundamental transformations will require commitment to establishing key aspects of an enabling environment: establishing a vision and tracking progress; building an integrated policy framework; governance for green growth; human capital formation and ensuring a fair and inclusive transition. In particular, defining an integrated policy framework that synergizes demand-side and supply-side policy interventions is a critical aspect of any strategy for long-term transformation, as discussed in the following sections.

Reforming economic incentives

Building the engine for green growth and the required integrated policy framework in the Asian and Pacific region requires a focus on reforming two key determinants of investment flows and resource-use patterns. The first, discussed in this section, is the price structure of the economy, as determined by the incentives framework. In the next section, the second determinant—the "physical infrastructure" of the economy (that is, the human-made infrastructure and natural capital)—is discussed.

Greening of growth requires a policy framework that at the most basic level, integrates policies that boost economic growth and those that, at the same time, provide incentives for reducing resource use and environmental pressure by changing price signals. Price signals are provided by markets and impacted by institutions and policies that govern the actions of all economic agents.[5]

At the heart of an incentives framework for green growth is green tax and budget reform to secure both improved human welfare and reduced environmental pressure. This includes ecological tax, or eco-tax, reform, pricing-structure and subsidies reform, and budget reform. Eco-tax reform undertaken in the context of green tax and budget reform efforts is a key cross-cutting, integrative policy tool that can reduce some of the fundamental economic-environment-social development trade-offs that are the basis for unsustainable economic growth patterns. It offers the potential to address both economic and environmental issues at the same time, as well as to minimize regressive impacts through careful policy design and revenue recycling.

As stated previously, when the social and ecological costs of resource use are not reflected in market prices, resources are used in greater quantities than if prices better reflected their true costs. For instance, low energy prices that do not take into account pollution and health costs can encourage inefficient and polluting forms of energy.

Taxing bads, not goods. Eco-tax reform consists of shifting the tax burden from welfare reducing taxes (such as taxes on labour) to welfare enhancing taxes (such as taxes on resource use and pollution discharges). Markets can be reformed by applying green taxes to the "bads"—such as pollution discharges or the inefficient use of resources—and reducing tax or financial burdens on the "goods"—environmentally and socially viable production and consumption patterns.

This approach, which can be made revenue neutral if appropriately designed and adjusted over time, would not increase the overall tax burden. Instead, it can have a positive impact on employment and polluting behaviour by providing incentives for production and consumption that are cleaner and make more efficient use of resources. It also helps to increase the political acceptability of changes in price structures of key commodities.

Eco-tax reform may give governments a double dividend by shifting investments towards environmentally beneficial activity while boosting growth by reducing labour costs (for example through lower tax burdens). Significant impacts of eco-tax reform have been recorded. In Germany, a four year eco-tax reform plan that started in 1999 systematically shifted taxes from labour to energy. By 2001, the use of fuel had declined by 5 per cent and the renewable energy sector experienced accelerated growth. By 2003, 45,400 permanent jobs had been created in the wind industry alone, with this number projected to rise to 103,000 by 2010.[6] Eco-tax reform also has the potential to help reduce some of the fundamental economic-environment-social development trade-offs that are the result of policy tensions created by economic growth strategies and resource constraints (Box 3.2).

Tax systems are most effectively modified within a broader budget reform and a flexible system of budget redistribution. A wide range of product

Box 3.2: Reducing policy tensions: enhancing investments in human capital

In most countries, increased inputs of energy and other resources, the use of more cost-effective technologies and the implementation of better management practices have undeniably improved labour productivity and boosted economic growth. However, these measures have given rise to policy tensions that have hindered sustainable development.

The challenge posed by green growth is to achieve continual gains in labour productivity (and living standards) while simultaneously reducing energy and resource inputs (and so enhancing prospects for environmental sustainability). Reducing the trade-offs between growth and environmental protection requires a close look at the nature of incentives regarding the use of both natural and human capital. Eco-tax reform, which reduces the cost of employment and job creation and simultaneously increases the economic burdens of wasteful energy and resource use, is a key policy instrument that can help achieve the integration of these objectives.

fees, product surcharges, environmental user fees, natural resource fees and pollution discharge fees or taxes can be applied to alter consumption and production behaviour. For example, in China, a standard road tax was replaced in 2009 with a fuel tax, which maintains government income but encourages energy efficiency.

An eco-tax reform package should be coupled with fiscal reform measures to recycle (as appropriate) new revenue or savings from environmental taxes or subsidy reform to companies and consumers most directly affected in a way that encourages their investment in further resource and cost savings (for example, coupling higher electricity prices with incentives for renewable energy technology deployment or household energy efficiency measures). In this way, closing the price gap can help to also close the time gap so that those affected can shift their consumption patterns in response. Over time, savings to government can also accrue, for example from reduced expenditure on energy subsidies that can be spent in socially-beneficial ways.

Also, an eco-tax reform package must be carefully designed to mitigate regressive impacts. However, the potential of negative impacts on the poor may be overstated. For example, a study in Indonesia based on a multisector, general equilibrium model to assess the effects of a carbon tax and energy pricing reforms[7] suggested that, in contrast to most studies from developed countries, the introduction of a carbon tax would not necessarily be regressive. It was shown to be strongly progressive in rural areas, and either neutral or slightly progressive in urban areas, with overall progressive distributional effects nationwide. For energy price reforms, the results suggested that recognizing the difference between urban and rural household income and expenditure patterns is crucial in order to minimize adverse distributional impacts. This and similar studies have shown that there is not necessarily a conflict between environmental and equity objectives, especially when the policies or reforms to achieve environmental goals are carefully designed and tax shifts are phased in gradually and predictably.

Subsidizing goods, not bads. Subsidies are important economic instruments that provide incentives for production, reducing economic burdens for both businesses and people. While subsidies are politically attractive, they can discourage conservation and efficiency improvements and do not always benefit lower-income groups; sometimes they benefit the more affluent. For example, in Indonesia an estimated 40 per cent of high-income households benefited from 70 per cent of the fuel subsidies, while 40 per cent of the poorest households only benefited from 15 per cent.[8]

In contrast, subsidy reform that is complemented with measures to enhance the potential for double dividend can be a cost-effective means for achieving environmental protection, economic development and energy security,[9] as well as meeting social needs better. In Indonesia, energy subsidy reductions were coupled with cash transfers to low-income households to mitigate the impacts of the resulting higher energy prices (Box 3.3). The need for subsidy reform is becoming widely acknowledged, with the G-20[10] agreeing in September 2009 to gradually phase out fossil fuel subsidies.

The IEA estimates that fossil fuel subsidies increased from $342 billion in 2007 to $557 billion in 2008 and that their suggested phasing out between 2011 and 2020 would reduce carbon dioxide emissions by about 6.9 per cent.[11] A review of fuel price trends across the region shows that subsidies were reduced or removed in many countries of the region between 2004 and 2006, but reintroduced or increased again by 2008.[12]

However, targeted subsidies can encourage the use of greener technologies and more efficient resource use. For instance, perverse subsidies for fossil fuel use can be redirected to renewable energy and technologies that promote energy efficiency in all stages (production, transmission and use), thus boosting the transition towards sustainability and green employment.

Internalizing the economic values of ecosystem services. Recognizing the value of ecosystem services in the economy is a key aspect of reforming the incentives framework. Goods and services produced by ecosystems can have enormous economic values at local, national and global levels (Box 3.4). The maintenance of natural capital helps secure these values, while also contributing to economic development.

However, as markets often fail to capture the economic value of the goods and services provided by nature, they are typically not accounted for in national accounts and rarely

Box 3.3: Subsidy reform and poverty reduction in Indonesia

The budgetary implications of high oil prices and fuel subsidy policies have led to actions to reduce subsidies and restructure energy prices in a way that has allowed the government of Indonesia to simultaneously reduce its expenditure on energy and increase its investments in human capital. Between 2001 and 2008, fuel subsidies ranged from 10 to 28 per cent of the national budget. In response, fuel prices were increased by an average of 29 per cent in March 2005, 114 per cent in October 2005 and, in 2008, subsidies of premium fuel, and kerosene were increased by some 25 per cent and diesel by some 28 per cent.

The removal of subsidies is a politically sensitive issue and has, in the past, led to protests and violence. However, Indonesia diverted the savings from the fuel price increases to mitigate the impact of the reform on the poor. The government spent about a quarter of these savings on an unconditional cash transfer programme called Bantuan, Langsung Tunai (BLT). A direct cash transfer has the advantage of being able to easily target a specific group and its cost is usually known with certainty. Approximately 19.2 million low-income households were given $10/month over a period of six months. Eligibility for payment was based on specific criteria, including income. An information campaign was undertaken and the programme was accompanied by other short-term measures for alleviating the impacts of price increases.

The reduction in fossil fuel subsidies was estimated to have saved $4.5 billion in 2005 and a further adjustment saved $10 billion in 2006. The BLT programme helped compensate for the rise in poor households' living costs and may even have offset poverty growth rates, at least in rural areas. The number of people below the poverty line decreased from 16.66 per cent in 2005 to 16.58 per cent in March 2007. One study projects that, without the BLT, the fuel price increases could have increased the poverty rate to 22 per cent. The welfare-support programme also helped reduce political and social opposition to the fuel price increases.

Source: Christopher Beaton and Lucky Lontoh, *Lessons learned from Indonesia's attempts to reform fossil-fuel subsidies* (Winnipeg, International Institute for Sustainable Development, October 2010).

Box 3.4: Economic value of ecosystem goods and services

Calculating the full economic value of healthy ecosystems is highly complex, as many services, such as protecting coastlines, creating sediments for beaches and exchanging gases, do not have easily established market prices. Estimates based solely on economic net benefits tend to be too low. A recent report highlights the values of ecosystems. An analysis shows that coral reefs provide a range of economically important services: natural hazard management (valued at up to $189,000/hectare/year), fisheries (up to $3,818/hectare/year), genetic material and bio-prospecting (up to $57,000/hectare/year), and tourism (up to $1 million/hectare/year). The values are site-specific. Another example is a coastal wetland in northern Sri Lanka which, through its function of attenuating floods, provides an economic contribution of $1,907/hectare/year, and, through its function of treating industrial and domestic wastewater, contributes $654/hectare/year to the economy.

Source: The Economics of Ecosystems and Biodiversity (TEEB), *Mainstreaming the economics of nature: a synthesis of the approach, conclusions, and recommendations of TEEB* (Nairobi, TEEB, 2010).

impact production, consumption and land-use decisions. The absence of appropriate incentives invariably leads to the degradation of these ecosystems. Appropriate pricing of ecosystem goods and services can help ensure that the economic values of these good and services are better reflected in the decisions of consumers and producers, and in the measure of a country's economic activity.

Various policy instruments are available to facilitate the internalization of economic values of ecosystem services, including: (a) environmental taxes or user fees, such as fees and payments for eco-tourism or charges for energy and water use that depend on the services provided by watersheds (for example, for hydropower production) or forests (for example, for carbon absorption in the case of

thermal power plants); (b) targeted subsidies that help encourage resource conservation; (c) open trading under regulatory cap or floor in which a mandatory maximum or minimum of a specific ecosystem service is defined, as in the case of wetland mitigation banks in the United States or the regulated carbon markets; (d) baseline-and-credit markets in which the polluter pays for the negative impact they impose on the environment by purchasing credits or offsets, such as the voluntary forest carbon market and biodiversity offsetting (e) private and direct deals between ecosystem service beneficiaries and land managers in which land managers are directly compensated for sustaining or enhancing ecosystem services; and (f) eco-labelling in which the payment for enhanced ecosystem service is embedded in a product that is produced under a management system that enhances or maintains environmental service provision.[13]

Ecosystem service values can have both local and national significance. In many cases, revealing ecosystem service values in local markets can have more immediate, targeted and sustainable benefits.[14] Capturing international opportunities presented by the carbon or biodiversity payments have much higher values, but more complex governance arrangements.

Regulation, compliance and enforcement. In many cases, market incentives work best when supported by or complemented with well-designed and effectively implemented regulations. Market-based incentive schemes have a better likelihood of success if part of a policy package that integrates regulations establishing clear standards for the use of resources, such as in green building codes. Experiences in forest management show that a moratorium on logging backed up by incentives for sustainable management and protection can work better than either approach on its own.[15]

Regardless of the nature of the instruments being used, their successful implementation requires effective administrative, monitoring and enforcement capacities. Effective compliance and enforcement continue to pose challenges due to weak political will, low technical and institutional capacity, inadequate human and financial resources and, in some cases, corruption. Government agencies must be equipped with the capacity and resources necessary to conduct their compliance enforcement functions and must be free from political interference in the implementation of compliance fines and penalties. Without a strong and credible compliance enforcement system, no incentives framework will deliver the behavioural changes necessary to achieve green growth (Box 3.5).

Financing green growth. Given the 2011 economic crisis and uncertainty about the continued availability of committed public financing, it will be essential to increase investment and participation by the private sector, which has been reluctant to invest in green sectors at the necessary scale. Recalibrating the economy would set the stage for economically viable investments in greener growth. However, action to close the price gaps between market prices

Box 3.5: The Asian Environmental Compliance and Enforcement Network

Recognizing that Asia has many environmental laws, regulations, action plans and programmes that are not being effectively implemented, the Asian Environmental Compliance and Enforcement Network (AECEN) was created by several of the region's national and subnational environmental agencies with assistance from the United States Agency for International Development and the Asian Development Bank. AECEN's mission is to promote improved compliance with environmental policies, laws and regulations through the exchange of innovative policies and practices. AECEN's operational modality relies heavily on South-South cooperation, in the belief that most environmental agencies have been through similar environmental challenges and good practices are best shared among peers.

In October 2009, environmental agency leaders from 14 Asian nations and the United States committed to strengthen enforcement and compliance of environmental laws at a meeting organized by the United Nations Environment Programme and AECEN, hosted by the Singapore National Environmental Agency. The countries issued a joint statement calling for Asian governments to promote improved environmental compliance with national legal requirements and international commitment.

Source: Asian Environmental Compliance and Enforcement Network, accessed from www.aecen.org/ on 1 July 2010.

and prices that reflect both ecological costs and benefits needs to be complemented by action to close the time gap.

While affordability and efficiency go hand-in-hand and green investments can deliver large benefits, they often do so only after many years and after significant upfront costs. The use of high discount rates to assess the financial viability of such investments often makes them financially undesirable, requiring longer-maturity loans than are typically available in commercial markets. Other barriers to financing green projects include high project development costs, small scale of projects (significant transaction costs, big banks not willing to finance), and projects failing to meet the "asset-based" lending practices of financial institutions.

Collaborative action between governments and the private sector should focus on overcoming these and other barriers and risks that restrict capital flows into the sectors that support green growth. Governments play an important role in providing incentives through clear regulatory and institutional frameworks for increased finance and for various partnership arrangements, with clearly defined roles for all parties.

At the same time, developing countries must also increasingly look for new economic opportunities and competitive advantages as part of the green transformation as, at present, most cutting-edge technologies and their applications continue to originate in the developed world. There is considerable potential for local innovation. While the majority of clean technology, or clean-tech, start-ups in developing countries do not invent new technologies, many have come up with innovative ways to turn existing technologies into useful market products. Many companies are also agile enough to develop products that can meet the customized needs of local markets by applying a variety of existing technologies and know-how.

China, in particular, views clean-tech as a growth sector and is aggressively moving forward to develop the market. In 2008, China was easily the largest producer of clean-tech in monetary terms, earning more than 44 billion euros, or 1.4 per cent of its GDP,[16] leading the world in many clean-tech sectors, including wind turbines, solar photovoltaic hardware, and high-speed rail technologies.

Following the example of China, countries can pursue various interventions to target different stages of the capital investment cycle. For instance, at the "innovation stage"–the stage at which technologies are initially developed–Asian-based clean-tech start-ups require targeted finance to help them overcome the high and front-loaded capital costs of projects. At this stage, public funding is required for early research and development and also to stimulate the movement of venture capital towards climate change and clean energy investments (Box 3.6).

At the critical, technology deployment phase—when technologies are scaled up for local application—public-private partnerships (PPPs) are needed, with public funding used to help shoulder the initial project development costs. To this end, governments must enact strong institutional arrangements for procurement, audit, dispute resolution and adjudication, backed by strong regulatory, protection and prosecution provisions. Such arrangements are essential for healthy bidding and award of contracts (to prevent the use of non-competitive, irregular or illegal practices for winning contracts). Public sector funds can also cover specific risks that commercial partners have difficulty managing,

Box 3.6: Venture capital for clean technology

The Asian and Pacific region is still far behind North America and Europe in accessing venture capital for clean technology. The global share of such investment in China and South Asia, where most such investment in Asia occurs, is around 10 per cent. However, recent discussions by the Asian Development Bank with fund managers in Asia have confirmed substantial venture capital market growth opportunities. Thus, there is hope that Asia will take up an even larger portion of global clean technology venture capital investment, which grew from just $2 billion in 2005 to $7.8 billion in 2010.

Source: Cleantech Group, *Record number of clean technology venture investment deals in 2010, as total amount invested rises 28 percent to $7.8 billion* (San Francisco, January 2011), accessed from http://www.cleantech.com/2011/06/05/record-number-of-clean-technology-venture-investment-deals-in-2010-as-total-amount-invested-rises-28-percent-to-7-8-billion/ on 4 February 2011.

such as political and regulatory risks. In some cases, public funds can be used to cover the potential "first loss" from investments.

Finally, domestic financial markets must play an increasing role in sustaining finance to avoid the so-called "double mismatch" problem that sparked the 1997 financial crisis (that is, maturity mismatch and currency mismatch in the balance sheets of financial firms and their client firms). In this effort, long-term bond market development and investment guidelines that enable banks, insurance companies, pension and provident funds, and other financial institutions to finance infrastructure projects will be important. Since 2008, the World Bank has issued more than $2 billion worth of "green bonds" that have been purchased mainly by institutional investors;[17] this level of investment will likely need to be scaled-up by at least two orders of magnitude for sustainable infrastructure development alone in Asia.

Pension reform can also stimulate private investment in developing Asia by promoting sound and efficient financial systems. By effectively mobilizing savings and catalyzing the growth of large institutional investors to manage the growing pool of pension assets, well-functioning pension systems contribute to the development of stock and bond markets.

Sustainable infrastructure

The extent to which an economy will "grow green" will depend on its ability to reduce the quantity of resources required over time to support economic activity. To accomplish this, investments in built environments, including housing, transportation networks, energy and water supplies, must focus on maximizing long-term savings in resources, while meeting the needs of people.[18, 19, 20]

As discussed in Chapter 1, Asia's cities are predicted to be the centres of global economic growth in the foreseeable future while urban centres in the Pacific are growing at record rates. About two thirds of the $8.0 trillion needed for infrastructure investment in Asia and the Pacific between 2010 and 2020[21] will be in the form of new infrastructure, which creates tremendous opportunities to design, finance and manage infrastructure according to principles of sustainability, accessibility, eco-efficiency and social inclusiveness.

Conversely, the window of opportunity to change resource-use patterns is closing, as the development of conventional infrastructure locks regional economies into unsustainable patterns of resource use for many decades, reducing the prospects for sustainable outcomes. Inappropriate planning has long-term consequences that can be reversed only at very high cost. For instance, a building designed without sufficient attention to water and energy efficiency results in decades of wasted energy and water, unless it is retrofitted at a cost generally much higher than if water and energy efficiency measures had been part of the original design. Similarly, the design of the road and public transport infrastructure affects for generations the location of households and enterprises as well as choice of transportation modes.

Benefits of sustainable infrastructure. Planners and decisionmakers are increasingly aware of these issues and are paying attention to sustainability considerations in infrastructure investments. Sustainable infrastructure offers an alternative to business as usual. Building sustainability into infrastructure involves replacing and upgrading existing infrastructure with more eco-efficient systems and building around the needs of people at a scale that reduces operating costs and increases accessibility and social inclusion. Through integrated approaches, sustainable infrastructure also can help provide multiple environmental, economic and social benefits. For example, investments in sustainable transport and urban planning help reduce greenhouse gas (GHG) emissions and air and water pollution, while improving urban mobility, access to markets, public health and the investment climate.

Sustainable infrastructure need not cost more than conventional infrastructure if investments are sequenced and financed appropriately, balancing up-front capital costs with lifetime operating costs. Investing in efficiency normally pays for itself in resource savings and can offset the need for some large-scale centralized infrastructure. However, the realization of huge potential efficiency gains remains hampered by a lack of instruments to monetize the benefits of conservation and efficiency and to reward sustainable consumption.

In addition, with infrastructure financing constrained by more vigilant management of financial risk, a strong case can be made in some

cases for modular and scalable design approaches, which start with relatively smaller budgets and lower risk. As discussed further in Chapter 5 for the case of energy systems, decentralized systems (for example, for water and energy supply) can be community owned and quickly built, offering a viable alternative to centralized systems under the right circumstances.

While cities in the Asian and Pacific region strive to develop in a sustainable manner, renewed attention has been placed on the concept of "eco-cities" and its applicability in the region. China, for example, has recently launched a pilot development of low-carbon cities in five provinces in order to identify a model for Chinese cities to lower GHG emissions, maintain economic growth and develop a more harmonious society.[22] The Government of India has launched the Jawaharlal Nehru National Urban Renewal Mission (JN NURM) to address the massive need for expansion of physical infrastructure and access to services in a sustainable and inclusive manner.[23] ASEAN countries are exploring practical models by sharing good practices though the ASEAN Working Group on Environmentally Sustainable Cities.[24]

No agreed or commonly accepted definition of eco-city exists, but many efforts have been made to conceptualize the sustainability of cities from different perspectives. Some approaches have focused on analysing cities as input-output models, looking at resource flows and identifying the best technical solutions; other approaches have focused more on socio-economic and governance processes.

While many lessons can be learned from experiences in already developed and highly urbanized regions, the pace, magnitude and dynamics of urbanization in the region are unprecedented and developing countries in Asia and the Pacific will need to develop their own understanding, concept, model and solutions for developing eco-cities.

Many solutions have been tried in the region in the last few decades, with mixed results at best. Only Singapore,[25] some eco-towns in Japan[26] and other isolated cases stand out as success stories, but their replicability remains a concern. A wealth of information exists on technical solutions to sustainability issues related to urbanization, but governance appears to be the critical factor. Experiences show the limitations of entirely top-down approaches, which need to be balanced with bottom-up initiatives and more inclusive and participatory approaches to urban infrastructure development.

Priority areas for sustainable infrastructure. Four key areas of sustainable infrastructure are discussed below clean energy, water and sanitation, sustainable transport, and solid waste management. To a large extent, the planning, implementation and management of each of these areas cannot be considered in exclusion from other areas.

Buildings and transport systems have considerable impact on how energy, water and waste are used for decades after their construction. Thus, with rising rates of urbanization and the expansion of Asian mega cities, integrated approaches are badly needed to ensure long-term environmental sustainability. For example, without careful planning in the transport sector, switching fuels will have much less effect on reducing energy consumption. Under the right policy and institutional conditions, integrated approaches can stimulate new jobs and companies that specialize in clean technologies and services.

Unfortunately, integrated approaches are often difficult to implement due to institutional constraints. Different government bodies and, in some cases, the private sector are responsible for energy, water, sanitation, waste, planning, education, health and the overall financing of infrastructure development related to these individual sectors. Communication between the different organizations is often not sufficient, and ministries pushing for eco-efficient design are often comparatively weak. This can lead, for example, to the construction of public buildings that consume considerable energy and water resources over their lifetimes and generate large amounts of waste that, instead of being recycled, must be transported for disposal, thus using more energy.

In addition, while much of the recent interest has been in green industries and green growth, the huge backlog in investing in remediation and control of the present, persistent environmental problems (like air and water pollution) should not be forgotten. Countries in Asia and the Pacific have typically under-invested in environmental control and remediation and the investment gap has continued to grow as population and economic growth have outstripped government willingness to invest in these areas.

Energy. Investment in the energy sector can focus on improving energy efficiency, switching to cleaner fuels, and the expansion of renewable energy use to foster green growth. The sustainability prospects for the energy sector are currently mixed in the region. On one hand, many policy, regulatory and financial instruments are being considered, tested and utilized in the region to promote cleaner and more efficient energy use. On the other hand, despite declining energy intensities in many countries, these gains have been counteracted by huge increases in the use of fossil fuels. Also, few countries have committed to hard targets for energy efficiency and renewable energy, while large-scale centralized power plants are still favoured over distributed generation and energy-efficiency investments.

Improving energy efficiency is among the most cost-effective of the many actions needed for achieving green growth and mitigating climate change. Prioritizing investment in conservation and efficiency in an integrated manner can pay substantial dividends by, for example, helping to avoid or defer investments in new large-scale power plants, while providing additional funding for energy efficiency initiatives. Opportunities for efficiency gains abound on both the demand and supply sides, the latter via improvements in the production, generation, transmission and distribution stages and possibly by switching fuel (coal to natural gas).

Unfortunately, energy efficiency is a low priority under current business models. Utilities lose revenues and profits when they or their customers invest in cost-effective energy efficiency, which is a serious impediment to greater energy efficiency. At the heart of this problem is the perception of energy as technology-driven (for example, solar panels, coal-fired power plants, wind turbines) rather than as a service sector (for example, heating, cooking, industrial production, mobility).

In response, reforms are needed to help align the financial interest of utilities with the interests of their customers by having energy efficiency integrated into resource portfolios. This will require strong policies and high-level commitment to overcome institutional and policy barriers that hamper cooperation and synergy between different sectors. Innovative cross-sectoral policies allow domestic funding to be used in the most efficient and effective manner and can be supplemented by international and other sources of financing as required.

Through innovative financing mechanisms, measures that promote energy efficiency can serve as a basis for investments in expanding access to modern (and renewable) energy for the people most in need it, or in further energy efficiency improvements, as in Thailand (Box 3.7).

In addition, public policies that support a rapid increase in the installed capacity of renewable energy (as well as the expansion of energy storage to fully utilize intermittent renewable energy resources) can provide significant opportunities for both public and private investments. If developed on a large enough scale, renewable energy could help reduce the demand for fossil fuels as global economies continue to grow.[27]

In countries with very low electrification rates, the expansion of modern energy services needs to be integrated with rural development policies, programmes and institutions. Financing for energy services should not focus on just

Box 3.7: Promoting energy efficiency in Thailand

In Thailand, legislation in 1992 established the Energy Conservation Promotion Fund (ENCON Fund), which receives revenue from a small levy of about 0.04 to 0.25 Thai baht (less than $0.01)/litre on gasoline, diesel, fuel oil and kerosene sales. The annual revenue from this levy is $60 million to over $150 million.[a] The fund is used to promote energy conservation through research, development, demonstration projects, incentives (such as grants or soft loans), capacity building activities and policy studies. The Energy Efficiency Revolving Fund is funded by the ENCON Fund and specifically focuses on stimulating investment in energy efficiency by involving the Thai finance sector in providing low-interest loans for energy-efficiency projects.[b]

[a] Based on the exchange rate of 32 baht = $1.0, May 2010.

[b] Energy Futures Australia Pty Ltd and Danish Management Group (Thailand) Co. Ltd., "Thailand's energy efficiency revolving fund: a case study", prepared for the Asia-Pacific Economic Cooperation (APEC) Energy Working Group, accessed from http://efa.solsticetrial. com/admin/Library/David/Published%20Reports/2005/ ThailandsEnergyEfficiencyRevolvingFund.pdf on 20 June 2010.

installing decentralized technologies alone; the technology may be inappropriate for the climate and circumstances of the household or community, requires considerable maintenance that is not locally available, and/or does not take into account the current and future needs and plans of the region. The most effective expansion of clean energy services has been in countries where considerable planning, consultation and work has been undertaken to develop institutions that can supply and maintain the service required, coupled with policies and pro-poor financing schemes. As discussed in greater detail in Chapter 5, important measures being pursued in the region to promote renewable energy include renewable portfolio standards, feed-in tariffs and net metering.

Water and sanitation. The investment needs for water and sanitation systems in the region are enormous, while the social and economic returns on water supply and sanitation service investments are huge and compelling. Every $1 earns up to $46 in benefits to poor households and there are national benefits in savings from health care costs and gains from productivity, investment and competition.[28]

Water supplies and irrigation networks must continually be expanded and improved and supply-side measures must be accompanied by demand-side measures to improve the efficiency of water use. Water conservation and reuse programmes (analogous to energy conservation and efficiency programmes) can help ameliorate long-term water supply problems in a way that is far more economical than costly supply-side technological fixes.

In rural areas, efficiency gains relate to enhancing irrigation productivity (for example, through micro irrigation), developing new irrigation infrastructure (for example, drainage improvements, artificial recharge), and watershed development and rehabilitation (for example, physical restoration, coupled with sustainable management systems). In the urban sector, efficiency gains can be ensured by supporting non-revenue water reduction, tariff reform, improved asset management, network rehabilitation, and corporate restructuring. Community-based water provision models have been found to reduce leakage and increase access to water services in Jakarta[29] and Sri Lanka.[30]

To ensure these efficiency gains while also reaching underserved communities, water must be priced more universally and explicitly as an economic good. Further, its physical use must be governed by water markets and regulators who will ensure the right balance between competing uses. In this regard, the water-energy-food nexus, coupled with the climate change impacts, must now be the foremost consideration in the design of transformational water agendas across the region.

Establishing rights in water and enabling water markets to develop more fully will ensure that appropriate price signals for efficiency are sent, thereby promoting innovation and keeping costs low. In addition, investments in water reuse and recycling, rainwater harvesting, and groundwater recharge will all be required. All these measures will require a collaborative approach between the public and private sectors, and in the different levels of government, from central to local administrations. The case of Singapore (Box 3.8) is a potential model for the region.

For urban wastewater treatment, western-style centralized systems may not be a realistic option where financing constraints exist, as collection pipe networks may account for up to 90 per cent of the total system cost.[31] Rather, policies should promote modular waste treatment plants, including stand-alone systems and retrofits to existing sewer systems, reduction of losses in transmission networks, and end-use efficiency improvements that include on-site treatment and reuse in commercial and residential buildings.[32] For instance, the city of Beijing implemented local regulation for decentralized wastewater treatment systems in apartment and office buildings and in 2005 achieved an estimated 10 per cent water reuse rate.[33]

Furthermore, decoupling sanitation from the water cycle with available "dry" technologies will improve water security.[34] Waterless urinals,[35] other ecological sanitation systems and biogas digesters have a proven track record in the region. These systems are easy to deploy, simple to operate, quick to install and cheaper than centralized systems.

Sustainable transport. In the transport sector, fuel switching and improved vehicle fuel efficiency have helped to address health-threatening levels of transport-related air pollutants and have mitigated increases in GHG emissions. However, more sustainable transport options are required in the pursuit of green growth.[36]

Box 3.8: Managing water demand in Singapore

Cities that struggle with water scarcity and pollution can look to Singapore's experience in sustainable water management for solutions. A global leader in integrated water management, Singapore's Public Utilities Board (PUB) manages water supply, water catchment and sewerage in an integrated and holistic manner. It has succeeded in diversifying the city-state's water, while lowering non-revenue water to one of the lowest rates in the world.

A big part of Singapore's success is due to the integrated approach that complements supply-side measures with demand-side measures. Supply-side measures are developed through the "Four National Taps" strategy that identifies four key sources for development: local water catchments, imported water, NEWater (recycled wastewater) and desalinated water. Demand-side measures include consumption-based, progressive water tariffs and a water conservation tax, standards for household water fittings and education campaigns.

Water prices are set at a level to recover the full costs of producing and supplying it, as well as to reflect the scarcity of water in the country and the higher incremental cost of additional supplies. Having water tariffs that reflect the true cost of water production, supply and treatment frees up other funds for research and development to identify innovative and more efficient ways of treating and distributing water, and to construct new water supply sources to meet future demand. Other enabling conditions have included a high level of government effectiveness, strong political will, effective legal and regulatory frameworks and an experienced and motivated workforce.

All of these efforts have yielded positive results. Per capita domestic water consumption declined steadily from its highest historical level of 175 litres/day in 1994 to 156 litres/day in 2008, and the PUB aims to further reduce per capita domestic water consumption to 140 litres/day by 2030. Singapore is becoming more self-sufficient in relation to water. There is also a thriving water industry with more than 50 international and local companies active in the Singapore market.

Source: Asian Development Bank, *Every drop counts: Learning from good practices in eight Asian cities* (Manila, 2010), accessed from www.adb.org/documents/reports/every-drop-counts/every-drop-counts.pdf

Metro rail systems may be appropriate for some cities, especially for big cities with high transport demands, but these are costly and require sophisticated approaches to financing, tariffs, technology and operations. As an alternative, bus rapid transit (BRT) systems can provide the passenger capacity of a heavy rail system at lower cost by using dedicated bus lanes to provide faster, more efficient service. These can be combined with urban planning approaches that promote other public transport options and non-motorized transport.

Latin America's successful BRT systems could be widely replicated as a cost-effective option if planning and design are integrated with other measures to manage the demand for transport. Such systems are operating or being planned in several countries in the Asian and Pacific region, including China, India, Indonesia, and Thailand. Guangzhou's new world-class BRT system (recipient of the 2011 Sustainable Transport Award) integrates bike lanes, bike share and metro stations, raising the bar for all cities.[37] The recently commissioned BRT system in Ahmedabad, India, has also been successful.[38]

At the same time, cities will need to find better ways of managing growth in vehicle ownership and use. Policymakers will need to consider reforming energy and fuel subsidies. As has been demonstrated in Singapore, London and elsewhere, vehicle or road pricing mechanisms can play a central role in managing transport demand. These have the added advantage by generating financial resources to expand and maintain the urban transport network and systems. Revenues raised through appropriate pricing can help provide the resources required for the policies, institutions, technology, infrastructure and operations for low-carbon, sustainable transport systems.

Solid waste management. A resource-efficient economy will have to address consumption and production patterns as well as integrated solid waste management solutions if it is to deal with the mounting problem of waste that is being experienced across the region. Japan and the Republic of Korea have established policies to address specific aspects of the life cycle of products (for instance through extended producer responsibility), coupled with integrated

waste management (including source separation and waste recovery).

A broad range of national laws, including specific laws and regulations for specific waste streams, must be coupled with local efforts to promote integrated solid waste management. The cities that have enjoyed the most success in managing their waste sustainably have typically combined conventional solutions with affordable and community-based solutions that treat waste streams as resources and as business opportunities. Such approaches offer economic benefits through cost savings, income generation, new employment and promotion of new business opportunities.

To pursue such an approach, governments can promote appropriate and cost-effective technologies to manage partly recyclable products and unrecoverable wastes. They should also consider the potential contribution of informal waste collectors and resellers. Well adapted to local conditions, the informal sector uses labour-intensive methods and simple equipment, such as push carts, and can collect waste in places where conventional trucks owned by local governments or large companies cannot enter, especially in low-income neighbourhoods, slums and squatter settlements.[39] At the same time, attention must be paid to the working conditions of the informal sector to ensure that people are not exposed to unreasonable risks.

Investment in natural capital

The natural environment, specific ecosystems (such as wetlands, watershed areas, mangrove forests and coral reefs) and the biodiversity they represent and support, provide "natural capital," which is the basis for economic activity and for sustaining life. Sustainable management helps secure critical ecosystem services that support the economy— such as water regulation and flood control—but also enhance the potential for harnessing these services for economic transformation based on natural capital.

Facilitating targeted and appropriate investments in natural capital. The way in which the natural environment is managed will impact long-term economic prosperity, quality of life, and vulnerability to natural disasters and climate change. Ensuring appropriate investments in natural capital so that ecosystem service flows continue to support economies and societies is the basis for sustainable development.

The services that ecosystems provide are in increasing demand as economies and populations in the region grow. However, the degradation of ecosystems continues because of a lack of explicit policy focus on the economic benefits that they provide. Experiences from the region show that investments in natural capital, both those made directly by governments and indirectly, through measures to promote investments by stakeholders, can provide a more environmentally sustainable basis for economic activity, and so potentially promote greener growth. Key sectors for increasing the investments in natural capital include forestry, coastal and marine protection and agriculture, which is increasingly under pressure to meet multiple needs—for food, fuel feedstocks, and other agricultural commodities.

Preliminary work by The Economics of Ecosystems and Biodiversity (TEEB) study showed that investments in sustainable management of ecosystems have high rates of return over the long term, ranging from 7 to 79 per cent.[40] Governments in the region are currently the most important investors in sustainable management of natural resources. Different investment modalities are employed: national budgets, land-use zoning policies and regulations, direct management and rehabilitation, and establishment of protected areas.

Governments have made several important investments using these mechanisms within the last five years. An example is provided by Suncheon City in the Republic of Korea. The city turned its tidal ecosystem, with extensive wetlands and reed fields, into an eco-tourism attraction, which has generated 6,400 jobs and other economic benefits valued at $100 million.[41]

Indeed, many stakeholders will hold the view that maintaining ecosystem services is the responsibility of governments. However, policymakers face several challenges in securing such investments. Rising opportunity costs of sustainable management and continuing demands on national budgets (especially in developing countries) make sustainable management of natural resources increasingly difficult to achieve, from both national budgetary and local job creation perspectives.

As privatization and decentralization processes continue, and economic activity expands, it is

also important to note that that a growing proportion of the economic benefits of natural resource management is captured by private entities (such as tourism operators or bottled water manufacturers) or local governments.

Policymakers are challenged to: (i) identify ecosystem services that hold important existing or potential national or local value, as well as international value; (ii) increase the effectiveness of government investments; (iii) identify specific opportunities for engaging beneficiaries of sustainably managed natural resources as partners, where necessary; and (iv) capture opportunities from international demand.

Potential investors in ecosystem services may be categorized as "direct" and "indirect" beneficiaries.[42] Direct beneficiaries are usually commercial entities that capture economic benefit from goods and services provided. Indirect beneficiaries receive economic benefit through commercial entities, as shown in Table 3.1. Investors can be both local and international.

The willingness of the private sector to invest in sustainable natural resource management may be higher than expected. In the Philippines, a study of 25 government and privately owned companies demonstrated that 84 per cent of the companies were convinced of the business case for investments in ecosystem services.[43] Ecosystem degradation can pose a number of risks to corporate performance: operational, regulatory, legal, financial and reputational as well as market- and production-related.[44] As an example, research in Viet Nam shows that the Da Nhim hydropower plant would lose $3.75 million/year in added operating and plant costs if 45,000 hectares of pine forests were converted to agricultural purposes.[45]

Facilitating investments from each group of investors requires different policy interventions and investment mechanisms, as shown in Table 3.2.

Payment-for-ecosystem-services (PES) arrangements provide a way to encourage investments in natural capital. Direct PES schemes involve the "purchase" of an ecosystem service from an ecosystem service provider (for example, a land owner or community forest organization), who agrees to specific ecosystem management arrangements in return for a payment or reward. In this way, the "buyer" can make an investment that, ideally, ensures that the ecosystem service will be delivered for the period of the agreement.[46]

For example, under an agreement between a water utility and small farmers in a watershed, the farmers can be paid for ensuring that their farming activity does not reduce water quality or quantity. In addition to helping the water utility to make an investment in securing future water quality and reduce operational costs for water treatment, such a scheme could resolve or prevent conflict around land use. Allocating a monetary value to

Table 3.1: Beneficiaries of sustainable management of forests

Forest ecosystem service	Direct beneficiaries/users	Indirect beneficiaries/users
Hydrological services	• Water utilities • Hydropower producers	• Intensive water users – all economic sectors and households • Hydropower users – all economic sectors and households
Scenic/landscape beauty	• Enterprises providing eco-tourism and nature-based tourism-related services	• Tourists
Biodiversity support	• Bioprospecting interests • International conservation interests • Enterprises providing eco-tourism and nature-based tourism-related services	• Drug purchasers • Individuals • Tourists
Climate regulation services	• Investors in carbon markets • Carbon offset intermediaries • Greenhouse gas emitters • Energy-intensive industries	• Carbon offset purchasers • Non-hydropower, non-renewable energy users in all sectors • Global community

Table 3.2: Investment modalities and policy support from governments for investments in sustainable natural resource management

Modality	Governments	Companies and other institutions (Direct beneficiaries)	Consumers (Indirect beneficiaries)
Investments	• Direct budget allocations • Establishment of protected areas • Community forest arrangements and financial incentives	• Land purchase • PES financing • Carbon offsets • Co-management approaches with communities • Eco-efficient production and consumption (lower environmental impact)	• Carbon offsets • Green fees (water, electricity) – through PES arrangements • Price premiums for natural products or nature-based products (for example, coffee)
Policy support required from governments	--	• Tax breaks • Establishment of payments for ecosystem services policy and mechanisms • Establishment of biodiversity banks • Securitization (environment bonds) • Green tax and budget reform	• Tax breaks • Eco-labelling and other information policy tools • Support for establishment of payments for ecosystem services policy and mechanisms • Green tax and budget reform

ecosystem services in this way can, therefore, improve the incentives for managing ecosystems for their long-term benefits that may accrue to the wider society. Under the right conditions, other benefits include increased societal awareness, the potential for smart infrastructure investments and cost savings, more effectively-enforced land-use planning and zoning regulations, and poverty reduction.[47]

China has one of the largest PES arrangements in the world to protect its degraded watersheds, mainly through large national public payment schemes. Viet Nam has also taken the important step of providing a legal basis for payments for ecosystem services, which has facilitated investments by hydropower companies and water utilities in watershed management (Box 3.9), while many PES-like arrangements on a smaller scale exist in other countries in the region.[48]

Despite these recent accomplishments, the ability of a wide range of potential voluntary "buyers" to invest via PES is still limited by the lack of appropriate mechanisms for ecosystem service providers to receive and use such investments.[49] Most successes have been small in scale. For instance, one scheme in Lombok, Indonesia, has been able to secure regular investments from household and commercial water users. This arrangement has found a sustainable source of financing, willingness to pay from even low-income beneficiaries of forest ecosystem services (water provision in this case) and the backing and policy support needed from new district regulations.

Revealing ecosystem service values in local markets can have immediate, targeted and sustainable benefits.[50] However, systems of tradable rights on the use of global environmental assets offer opportunities to address "local problems of the global commons." Investment policies and mechanisms (such as those presented by carbon or biodiversity payments) can be elevated to a national and regional policy level in order to deliver a fundamental change in the incentives for, and impacts of, investment in sustainable natural resource management.[51]

An emerging development is the creation of markets for carbon emission reductions from reducing emissions from deforestation and forest degradation (REDD). Several REDD pilot projects are being promoted in the region, combined

Box 3.9: Pilot policy on payments for ecosystem services - Viet Nam

In Viet Nam, a pilot policy for payments for forest ecosystem services (FES), established by Prime Minister's Decision 380/QD-TTg of 30 April 2008, established pilot sites in Lam Dong and Son La provinces with core support from the Asia Regional Biodiversity Conservation Programme. Under the policy, forest protection and development and the conservation of forest ecosystems, biodiversity, and forest natural landscapes are considered services for which individuals, businesses and organizations that use and benefit from them must pay the service providers—forest owner organizations and households contracted for forest protection.

After almost two years, the preliminary impact of Decision 380/QD-TTg was evident. At the Lam Dong pilot site, hydropower and water supply plants made investments in improving water quality and regulating water flow through improved forest management. These investments totalled some $5.2 million in 2008-2009. These funds were allocated to make FES payments to participating forest-managing households at a rate of $14–15 (VND 270,000-290,000)/hectare, with an average of 25.4 hectares (ha) of forest land managed by each household.

As a result, the awareness of people in all sectors and at all levels has been raised; forests in areas that received payment for FES were reportedly better protected, with the incidence of illegal logging offences reduced by 50 per cent and poverty rates in the pilot area reduced by 15 per cent. The livelihoods of households involved in forestry were also improved. High-ranking officials underline that "this has created a high level of consensus among people, the agencies at local level, and especially the payers. They have understood that payment for FES is an investment for the sustainable development of hydropower plants, eco-tourism, and clean water supply plants."

As of June 2010, allocations of 203,335 ha of forest had been made to 8,022 households. There has been a high level of participation from ethnic households. The province plans (a) to increase both the forest area allocated for protection and the payment level, (b) to apply information technology to strengthen monitoring, and (c) to refine the mechanisms for managing and utilizing the funds.

Source: Mr. Hoang Sy Son—Vice Chair of PPC of Lam Dong at the second South-East Regional Workshop on PES in Da Lat, Viet Nam, 21 June 2010. "Speech on the mechanism for payments for forest ecosystem services in Lam Dong."

with sustainable forest management, biodiversity conservation and community development (collectively known as REDD-plus). Under the right conditions, REDD-plus investments provide a unique opportunity to address both climate change and rural poverty while protecting fragile ecosystems, conserving biodiversity and sustaining resource-dependent livelihoods. Indonesia is the first country to identify national rules for distribution of income from REDD transactions.

REDD-plus is expected to be included in the post-2012 global climate regime. PES mechanisms can still play a significant role via voluntary market transactions and regional and bilateral agreements for example, the commitment by the Government of Norway to provide Indonesia with up to $1 billion in grant financing for REDD-plus activities). REDD is also incorporated into appropriations and pending legislation in Australia, the United States and other countries. In Asia and the Pacific, Indonesia, the Mekong Basin, Papua New Guinea, Solomon Islands and Vanuatu are poised to be significant participants in these actions and are among their largest beneficiaries.

It should be noted that many challenges are associated with the establishment of a credible system for organizing REDD actions, such as determining reference baselines of past trends and forest carbon stocks, channeling financing to appropriate actions, ensuring a fair distribution of the benefits and monitoring results.

Sustainable agriculture. Agriculture is seen as a key sector for increasing investments in natural capital and "sustainable" agriculture is widely viewed as means to do this. Essentially, sustainable agriculture involves meeting present food needs without compromising the rights of future generations. Ideally, it combines environmental, economic, social and equity goals,[52] while maintaining and building natural capital. The modelling work done for the UNEP green economy report, which allocates 0.5 per cent of GDP ($325 billion) to natural capital sectors: forestry, agriculture, freshwater and

fisheries, projects an increase in value added in the agriculture sector by about 10 per cent in 2050 as compared with business as usual through improved soil quality and increasing global yields for major crops.[53]

As discussed in Chapter 1, the agricultural sector faces increasingly complex challenges—competition for land and rising incentives for non-food crops, changing production and consumption patterns, environmental risks,[54] increasing food and water insecurity and the warnings of an imminent food crisis that will affect the poor the most, as well as climate change.[55] As with ensuring sustainable energy and water supplies, both demand-side and supply-side interventions will be required to ensure future food security. Dietary patterns are also moving unsustainably towards more animal protein from livestock, for which increasing quantities of non-food (fodder) crops (and corresponding increasing pasture lands) are needed, while rice consumption is declining.[56] Consumer education and awareness to influence future consumption patterns will be a major challenge for the region.

To meet the supply-side challenges, a second and rapid green revolution is needed to meet growing food demands, while strategies must be developed and implemented for optimal and eco-efficient use of agricultural lands, water and other agricultural inputs. It will be imperative to find the right balance between the need for short-term productivity gains and long-term sustainability.

For the short-term productivity gains needed, intensive agricultural systems must continue to play a key role, as huge leaps in the productivity of staple crops—the basis of the first green revolution—are again needed. The International Rice Research Institute (IRRI) points out that intensive rice farming systems are required to produce the quantities of rice needed to meet demand, which is increasing despite changing dietary patterns.[57]

For long-term sustainability, these intensive agricultural practices will have to become more environmentally sustainable and in part this will be driven by resource scarcity: farmers will have no choice but to use less water and land than in the past. Mineral fertilizer, particularly phosphate, will also have to be used more efficiently to avoid escalating prices and shortages. Other sustainability gains will come as a result of the work of international research institutions. For instance, IRRI and partners are developing "green super rice" varieties that are more robust, high-yielding, disease resistant, and that thrive with less water, fertilizer and pesticide.[58] Such varieties are termed more "eco-efficient'— more productive and requiring less inputs. If the major rice and wheat producing countries were to reach only the present global average yields of these crops, production using existing systems would increase by more than 12 per cent.[59]

However, although intensification of agriculture may satisfy the adequacy and stability pillars of food security, it has proven less than satisfactory in terms of food access and utilization. Thus, there is also a need to improve the ability of the poor to feed themselves. For poor farmers, this means increasing total farm productivity *in situ*, focusing on improving food production and raising incomes with low-cost, locally available technologies and inputs without causing further environmental damage and without compromising their ability to trade.[60]

Sustainable agriculture is generally equated with organic agriculture, that is, diverse crop-livestock systems in which mineral fertilizers and pesticides are avoided, thus minimizing pollution of air, soil and water.[61] While organic farming alone cannot meet future global food demand, promoting more labour-intensive, small-scale practices based on sustainable, multicropping systems (in tandem with more intensive practices) can help the poor and the environment (Box 3.10). Such efforts should be accompanied by the creation of market incentives for sustainably produced food by "greening" food markets and supporting producers, particularly smallholders.

These efforts should include harnessing the traditional knowledge of farmers and preserving genetic diversity as a basis for competitiveness and resilience. Experiences with supporting women farmers in the region have shown the importance of approaches that take gender considerations into account. In all the developing economies of the region, agriculture remains the most prominent employer of women, particularly in the Pacific islands and South Asia, accounting for 75 per cent and 71 per cent, respectively, of all female employment in 2009.[62]

In addition, while increasing food prices can provide some motivation to pursue more sustainable agricultural practices, fluctuations in market prices can be supplemented by payments that recognize the stewardship of

Box 3.10: Organic farming and integrated farming systems

Only at the organic farming end of the agriculture spectrum does natural capital increase, optimizing the health and productivity of interdependent communities of plants, animals and people.[a] The increase in natural capital is due, among other things, to better water retention in soil, improvement in the water table, reduced erosion combined with improved organic matter in soils, leading to better carbon sequestration, and avoiding loss of agro-biodiversity, as well as creating less pollution and using less energy. Such systems provide a diversity of food products and thus benefit consumers' nutrition as well as maintain soil fertility.[b]

Several examples of community-based organic farming initiatives can be found in Thailand and are a key response to the Sufficiency Economy strategy of H.M. the King of Thailand.[c] The important benefits cited include improved farmer health, as agrochemical inputs are eliminated or reduced, and an exit from the "debt cycle" in which successive harvests fund loan payments and new loans are taken to cover the costs of agro-chemicals, specific seeds and other requirements that may be imposed under contract farming arrangements.

Another "green" approach is more widespread application of integrated farming systems that provide energy as well as food, such as use of leftovers from rice crops to produce bioenergy, or in an agroforestry system, use of debris of trees used to grow crops like fruits, coconuts or coffee beans for cooking.[d] Biogas production using livestock waste to produce gas for cooking has long been advocated but so far not become popular among small-scale farmers. Such systems increase farm resilience to climate change and particularly benefit women because there is no need for them to leave their crops to go in search of firewood.

[a] N. El-Hage Scialabba, "Organic agriculture and food security", paper presented at the International Conference on Organic Agriculture and Food Security, Rome, May 2007 (Rome, Food and Agriculture Organization of the United Nations [FAO]).
[b] United Nations Conference on Trade and Development and United Nations Environment Programme, *Organic agriculture and food security in Africa* (New York, United Nations, 2008), accessed from www.unctad.org/en/docs/ditcted200715_en.pdf on 18 May 2011.
[c] King of Thailand, Royal Biography, *H. M. The King and His Agricultural Development Work*, accessed from http://kingofthailand.cgi.ac.th/king/AgriculturalDevelopmentWork1-en.php
[d] Food and Agriculture Organization of the United Nations (FAO) Media Centre, *Reducing poverty by growing fuel and food*, 17 February (Rome, FAO, 2011), accessed from www.fao.org/news/story/en/item/51165/icode/ on 18 May 2011

farmers for enhancing ecosystem services, such as biodiversity, aquifer recharge or soil erosion control. The extent to which farming for food can be made a more secure and rewarding economic activity through such ecosystem service payments requires additional research.

An enabling environment: key steps for more resilient economies and societies

As noted earlier, greening economic growth requires a policy framework that integrates policies that boost economic growth and those that provide incentives for reducing resource use and environmental pressure. This requires integrated strategies that support systemic changes (that is, shifts in social preferences and investment decisions that define the economy) in integrated, complementary and mutually reinforcing ways.

The complexity of the challenge means that success will depend on the ability to establish a clear vision and monitoring approach, developing an integrated policy framework, governance for green growth (including managing potential negative impacts), and human capital formation.

Establishing a vision and tracking progress

Reducing the intensity of resource use and pollution requires strong leadership and policy commitment that back a vision. Government action is needed to "jump-start" green growth. As discussed in Chapter 1, several countries have signalled their intent to improve different aspects of the quality of growth through high-level initiatives and policy frameworks, such as in China (aiming for a resource-efficient economy), Japan (working to reduce, reuse and recycle—

the 3Rs), Malaysia (developing a New Economic Model), Maldives (working for carbon neutrality); Republic of Korea (implementing low-carbon green growth), Singapore (implementing the Sustainable Singapore Blueprint), and Cook Islands, Fiji, Samoa, Tonga and Tuvalu (with ambitious renewable energy targets). Several countries have also established strategies and policies for low-carbon development that are not subject to legally binding mitigation commitments under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC).

To support such actions, indicators that demonstrate the efficiency of resource use in economic systems are needed to help track whether economies are becoming more or less eco-efficient over time. Indicators that measure the intended outcomes of green growth (and related social progress) are also needed. Such indicators could include, for example, the number of new green jobs created, the proportion of eco-certified products in total market share and the reduction in pollution-related health burdens or traffic congestion costs.

For targets (such as for reducing GHG emissions, increasing use of renewables) to be effective, a national system of monitoring and evaluation is necessary, that is, establishing a baseline against which progress can be measured and then monitoring and promoting progress at specific intervals. As well, the capacity of stakeholders has to be raised to independently identify and recommend ways to monitor progress and adjust strategies to achieve the targets.

Building an integrated policy framework

Shifts in social preferences and in investment decisions can only be accomplished by delivering green growth strategies that support systemic changes in integrated, complementary and mutually reinforcing ways. Policy integration has long been touted as a hallmark of sustainable development strategies, but it has been less clear what integration means in practice.

An integrated policy framework for green growth will seek more effective policies and will be designed to systematically influence the directions of investment in more environmentally and socially sustainable ways (Table 3.3), including pursuing low-carbon development (Box 3.11). Such a framework will synergise action to reduce environmental pressure and

Box 3.11: Low-carbon development

For developing countries, high priority should be placed on ensuring that actions related to climate change work for development. This means continuing economic growth; meeting poverty reduction goals; and providing access to energy, housing and other needs—but based on economies that are less carbon-intensive than is currently the situation.

Common elements of low-carbon development strategies that have been formally communicated to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat include (a) regulating energy demand, such as through investments in energy efficiency and infrastructure; (b) ensuring energy security based on increasing renewable and low-carbon energy sources of energy as a proportion of total energy used; (c) adopting supportive technologies and policies in non-energy sectors; and (d) managing land sustainably.[a] At the same time, the commercial and widespread uptake of low-carbon technologies requires policy and market support. Key for achieving low-carbon development is pricing carbon releases (by means of taxes or tradable permits).

Climate mitigation goals can directly support the achievement of development goals through multiple co-benefits that include reduced operating costs, increased access to energy services, greater community empowerment, and improved livelihood opportunities and quality of life. For example, improved cooking stoves can reduce greenhouse gas (GHG) emissions and emissions of black carbon[b] and thus also reduce the exposure of women and children to health impacts, such as upper respiratory tract infections.

Low-carbon development will require the full support of the private sector. The World Business Council for Sustainable Development[c] identifies a number of policy elements for engaging the private sector,

continued on next page.

including setting in place long-term stable policy frameworks that generate confidence for investment and mitigate some technology development risks; pricing carbon emissions; protecting intellectual property rights to ensure a return on research and development; letting markets determine the most cost-effective technologies and avoiding governments selecting technologies; promoting dialogue and cooperation between private sector and public research institutions, especially for those technologies that may not be commercialized in the short term; and ensuring the availability of a well-trained workforce through appropriate education in mathematics, science and engineering.

The opportunities for reducing emissions at the lowest costs are fragmented across sectors and regions. More than half of the potential for such reductions is in developing countries,[d] where investments in GHG emission reductions can be channelled towards meeting development goals. A comprehensive study of more than 200 GHG abatement opportunities across 10 sectors assessed the potential, costs and investment required in each sector.[e] The study found that many GHG abatement measures can be achieved while saving costs—at "negative cost'/ton of carbon dioxide equivalent. Such opportunities include (in order of their potential for cost savings) industrial GHGs other than carbon dioxide, standby losses, sugarcane biofuel, fuel efficiency in vehicles, water heating, air conditioning, lighting systems, fuel efficiency in commercial vehicles, and building insulation.

Targeting the lowest-cost mitigation opportunities is one strategy. However, mitigation strategies are probably best targeted at sectors that are responsible for high levels of GHG emissions, but that may benefit the most economically. One study of a range of industries in the Republic of Korea shows that some sectors with high emissions can reduce their climate impacts without significant impacts on their levels of output—and with little or no impacts on employment.[f] While the study found that action to reduce emissions increased productivity in several sectors (mining, non-metallic mineral products, electric power, water and gas supply), such action reduced productivity in others, including basic metal products, coal and petroleum and chemical products. Complementary measures are needed to support the sectors that are most vulnerable to action to reduce GHG emissions.

International cooperation is needed to ensure that countries that lead on the way in low-carbon development do not suffer short-term losses in competitiveness as a result, and that countries that are unable to invest directly in low-carbon development are not left behind. One such potential international coordination arrangement being discussed is a global "feed-in tariff" programme, which is proposed to apply a special purchase price for electricity generated from renewable energy sources.g Such a price incentive to renewable energy producers would generate further investment in renewable energy, eliminate the need for long-term price support and meet the need to improve access to modern energy in some developing countries.

[a] Christa Clapp, Gregory Briner and Katia Karousakis, *Low-emission development strategies (LEDS): technical, institutional and policy lessons* (Paris, International Energy Agency, 2010), accessed from www.oecd.org/dataoecd/32/58/46553489.pdf?bcsi_scan_9688B637A46568DB=lzRtMZabjr6TzdqTYoC5WvGKPNACAAAAHRKNBg==&bcsi_scan_filename=46553489.pdf on 16 February 2011.

[b] Black carbon is the product of the incomplete combustion of fossil fuels, and is an important contributor to climate change impacts from human activity. Using traditional fuels and burning fossil fuels inefficiently are significant contributors to regional emissions.

[c] World Business Council for Sustainable Development, *Innovating for green growth: drivers of private sector RD&D* (Geneva, 2011), accessed from www.wbcsd.org/plugins/DocSearch/details.asp?State=P&type=DocDet&ObjectId=MzkxNjA on 2 March 2011.

[d] McKinsey and Company, *Pathways to a low-carbon economy, Version 2 of the global greenhouse gas abatement cost curve - January 2009* (New York), accessed from https://solutions.mckinsey.com/ClimateDesk/default.aspx on 31 August 2010.

[e] McKinsey and Company, *Pathways to a low-carbon economy, Version 2 of the global greenhouse gas abatement cost curve - January 2009* (New York), accessed from https://solutions.mckinsey.com/ClimateDesk/default.aspx on 31 August 2010.

[f] R.H. Chun, K.H. Kim and K. Han, "Environmental regulation and its effects on competitiveness: the case of Korean industries", in R.K. Chung and E. Quah, eds., *Pursuing green growth in Asia and the Pacific* (Singapore, Cengage Learning, 2010).

[g] A feed-in tariff is a special purchase price which is paid by electricity companies for electricity generated from renewable energy sources as an incentive to renewable energy producers. The purchase price is typically higher than the price paid for electricity generated from other sources. See United Nations Department of Economic and Social Affairs (DESA), *World economic and social survey 2009: promoting development, saving the planet*, (New York, United Nations, 2009), accessed from www.un.org/esa/policy/wess/wess2009files/wess09/wess2009.pdf on 3 May 2010.

secure growth, address both demand and supply, build synergies between linked sectors, and deploy complementary and linked regulations and incentives.

Eco-tax reform, discussed earlier, is a key cross-cutting and integrative policy tool with the potential for resolving critical policy tensions. At a more basic level, the integration of

environmental sustainability and economic growth considerations can also be achieved by focusing investment in those economic sectors that, by their very nature, create both higher-quality jobs and support the reduction of energy and resource use. UNEP and the International Labour Organization (ILO) emphasize that more jobs for each unit of resource use are created

Table 3.3: Greening growth: strategies, policies, partners and investments

Strategy	Selected policies and examples of countries where implemented	Implementation partners	Investment focus
Sustainable infrastructure development	• Building codes for energy and water conservation (Singapore) • Energy and water efficiency incentives, price restructuring (Singapore) • Independent/decentralized power production (Indonesia, the Philippines, Thailand) • Vision and master-planning for sustainable infrastructure development • Incentives for restricting urban sprawl, eco-efficient renovation, ecological restoration • Land tax	• Local governments and city planners • Universities • Architects, engineers, contractors • Private sector • Financial institutions • Non-governmental organizations • Local communities	• Renewable energy technology • Human capital development • Mass transit development • Retrofitting of buildings • Community development funds
Investment in natural capital	• Payment for ecosystem services (China, Viet Nam) • Eco-labelling (agriculture) • Ecological tax reform, green fees, incentives for investment	• Community groups • Water and power utilities • Local governments • Businesses • Financial institutions	• Enabling policy development and awareness • Biophysical data
Greening markets, businesses and industries (including sustainable agriculture)	• Green procurement (China, Japan, Republic of Korea, the Philippines) • Eco-labelling (Australia, Japan, Republic of Korea) • Green technology investments • Eco-tax reform • Eco-innovation financing • Cleaner production programmes (Cambodia, China, Indonesia, Malaysia, Russian Federation, Sri Lanka, Thailand, Viet Nam) • Feed-in tariffs (Australia, Indonesia, Japan, Thailand) • Extended producer responsibility (Japan, Republic of Korea)	• Businesses • Research and development institutes • Clean technology centres • Private sector • Financial institutions	• Life cycle assessments • Cleaner production • Eco-industrial parks • Soft loans for green projects • Innovation agency development • Green technology • Human capital • Organic farming systems • Sustainable commercial farming systems

continued on next page.

Sustainable consumption	• Water and energy, resource pricing (Singapore) • Green procurement (Japan, Republic of Korea, the Philippines) • Information tools, including public disclosure and eco-labelling (China, Indonesia, Japan, the Philippines) • Extended producer responsibility (Japan, Republic of Korea)	• Private sector • Farmers • Universities • General public • Local governments • Financial institutions	• Demand-side management • Eco-labelling • Education and environmental awareness
Cross-cutting instruments	• Eco-tax reform • Internalizing the economic value of ecosystems; resource pricing; ecosystem service markets • Education for sustainable development • Human capital formation: skills development training		

by the renewable energy sector, for example.[63] However, in all economic sectors, especially those that might not be considered "green," action is needed to maximize the synergies between employment-creating growth and reducing environmental pressures.

Green growth seeks demand-side solutions, rather than "end-of-pipe" solutions, and so requires a greater focus on managing the demand for resources without compromising the ability to meet needs in an equitable way, or stifling growth.

Both demand- and supply-side interventions have to be supported through complementary and mutually supportive policies. For example, action on the greening of markets, is critical, but must be supported by action to support sustainable consumption. Demand and supply linkages can also be identified in terms of ecosystem services. For example, a more secure water supply can be achieved through both demand-side action in the form of incentives for more efficient water use coupled with supply-side action, where water fees or investments from water utilities can be invested in maintaining and restoring watersheds that provide water. In this way, action on both supply and demand side is synergized so that a critical economic input and environmental asset (water) can be better secured.

Governance for the greening of growth

Even with a policy framework geared towards green growth, actual reform can still fall short due to such factors as vested interests and institutional limitations. Overcoming these challenges of governance and management requires strong legal, regulatory and institutional frameworks, backed by political will and leadership, strong and predictable public sector management systems (for example, cross-sectoral coordination, sufficient human capacity, sound public financial management), appropriate levels of funding and a governance environment that fosters transparency, accountability and stakeholder consultation.

Perhaps the most important of these is high-level leadership, as showcased by the Republic of Korea's establishment of a Presidential Commission on Green Growth, which has guided the implementation of its Low Carbon Green Growth development strategy.[64]

The focus on cross-cutting policies requires that efforts to improve institutional development and capacity development be broad-based. High-level coordination is needed between ministries of environment and ministries of finance and planning. Integrated policy frameworks will require the engagement of several line ministries, such as those related to agriculture, industrial and economic development, energy, health and safety, natural resources management, land-use planning and transportation. These entities must all have clearly defined mandates, responsibilities and resources, with clear inter-agency cooperation mechanisms in place.

In coordinating with other agencies, environmental agencies should address gaps and overlaps in authority, and ambiguity in operational roles. Possible inter-agency cooperation

mechanisms can include interagency agreements that establish clear coordination procedures, joint research programmes and multi-agency committees or task forces.

In addition, recalibrating the economy and building integrated policy frameworks will mean dealing with the values, ambitions and goals of a multitude of stakeholders. Thus, policies should increasingly be evaluated from multiple viewpoints. Better "transition management" means that resources must be appropriately allocated and that the burdens of risk, as well as the benefits, be fairly shared.

Furthermore, greening of growth will rely far more on communication with stakeholders to encourage shifts in consumption and production behaviour. Education for sustainable development remains a basic requirement and many important grass-roots initiatives across the region are originating in schools. At the same time, information tools that also directly target specific industries, including eco-labelling schemes and public disclosure of firms' environmental performance, are needed (Box 3.12).

As stressed earlier, a transition to green growth will create winners and losers, especially in the short term. The costs and benefits of some measures may not be equally distributed. Thus, it will be important that specific measures are put in place to counter-balance the potential negative effects on the most vulnerable, especially the poor.

At the same time, the extensive environmental changes being observed, the degradation of ecosystems, and the potential scale of the projected impacts will require "adaptive governance" approaches that give increased importance to sustaining development in changing environments where the future is unpredictable and surprise is likely. As discussed in Chapter 5, resilience focuses on the capacity of societies and economies to resist shocks and disturbances and also to self-organize and grow in the face of unforeseen changes and uncertain conditions, such as catastrophic incidents caused by climate change.

Finally, there is also need for a more specific focus on certain aspects of governance. Among the key areas that need better institutional and legislative support are: (a) fiscal reform and economic incentives aimed at shifting funding as well as public and private decision-making in more sustainable directions, (b) institutions that bridge the gaps in knowledge and implementation capacities, (c) strengthened property rights, (d) explicit recognition of ecosystem services in law, (e) new indices for tracking progress towards sustainable development, (f) strengthened standards and regulations, and (g) effective

Box 3.12: Selected environmental performance and public disclosure schemes

China. Environmental performance rating and public disclosure (EPRD) programmes, informally known as green watch programmes, were first piloted in 2000 in two municipalities, and were expanded to 22 municipalities in 2005. On 11 April 2007, China's State Environmental Protection Administration (SEPA) adopted Decree No. 35 on Environmental Information Disclosure, which became effective on 1 May 2008. As of 5 June 5 2008, the Jiangsu provincial EPRD programme alone covered 14,957 firms.

Indonesia. Initiated in 1995, Indonesia's Programme for Pollution Control Evaluation and Rating Programme (PROPER) is generally recognized as a pioneer EPRD programme in Asia. In its initial phase of implementation, until it was temporarily stopped in 1998 as a result of the financial crisis, the programme targeted solely water pollution. Since the programme was re-launched in 2002, PROPER has evolved into a comprehensive rating of all aspects of a firm's environmental performance, across multiple media.

The Philippines. The Department of Environment and Natural Resources implemented in 1998 its own EPRD programme named the Industrial Ecowatch System, under the department's Administrative Order No.51, followed by an amendment of its implementation guidelines in August 2003. The Laguna Lake Development Authority has been particularly active implementing an Ecowatch System and rated and disclosed the names of more than 700 enterprises in 2008.

Source: E.G. Gozun, B. Laplante and H. Wang, "Design and implementation of environmental performance rating and public disclosure programs: a summary of issues and recommendations based on experiences in East Asian countries", *World Bank Policy Research Working Paper* (2011) No. 555 (Washington, D.C., World Bank).

monitoring and enforcement of environmental laws and regulations.

Human capital formation, creating winners and ensuring a fair transition

In any economic transformation, there will be winners and losers, and this will be no different in the pursuit of green growth. Environmental and equity objectives can only be achieved simultaneously when reforms to achieve environmental goals are carefully designed. One area of interface between environmental and equity objectives is the creation of new green jobs, along with the development of skills needed to succeed in a "green" market place. "Green jobs" refers to "the direct employment created in economic sectors and activities, which reduces their environmental impact and ultimately brings it down to levels that are sustainable." The projected benefits of new job creation are one of the most attractive features of green growth for policymakers.

ILO estimates that the projected number of green jobs could reach 100 million worldwide by 2030, of which about 50 million would be in Asia.[65] Renewable energy, in particular, is opening up opportunities for new green jobs (Box 3.13). However, policymakers must consider that job creation will largely take the form of job substitution, as the fossil fuel industry may lose jobs in coming decades.

Overall, the green growth industry is likely to be as capital-intensive as the present fossil fuel industry, but patterns of employment could change. For instance, (a) use of advanced technologies may eliminate low-skilled jobs, as is happening in many other industries; (b) renewable resources are available locally, which may reduce employment in transportation; (c) smaller enterprises would be more likely to participate in green growth industry (apart from hydropower, renewable resources will support smaller power plants) than would the large conglomerates now engaged in the coal, oil and gas industries; (d) the energy service industry (for example, offering energy conservation) will employ more than energy-producing companies; and (e) "local" jobs in the green growth industry may be better suited to women than existing jobs in mining and production, which tend to be located close to the fossil fuel resources.

Public policy can do a great deal to foster green jobs. However, long-term green growth prospects require education and skills programmes for qualified entrepreneurs and skilled workers to support job creation. Education for sustainable development is essential at all levels, formal and informal. School curricula and skills training need

Box 3.13: Green jobs potential in renewable energy

Global investment in renewable energy is expected to reach $343 billion in 2020 and to almost double again to $630 billion by 2030. These projections could translate into 20 million jobs in the renewable energy sector, more than the current jobs in the fossil energy industry (mining, petroleum extraction, refining and power generation), which has been shedding jobs despite rising production.[a]

Countries that are focusing on developing and deploying renewable energy stand to benefit enormously. China's renewable energy industry and its domestic market have grown significantly as a result of (a) the Renewable Energy Law of 2005, which targets a 10 per cent renewable energy share in the country's total energy consumption by 2010 and a 15 per cent share by 2020; and (bi) the Medium- and Long-Term Development Plan for Renewable Energy of 2007. Consequently, China is taking a leading position globally, particularly in wind power, solar water heating and small hydropower. These jobs can be expected to make up for the closure of energy-intensive industries as part of the country's efforts to reduce the energy intensity of the economy.

[a] As defined by the International Labour Organization, "decent work" sums up the aspirations of people in their working lives. It involves opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in decisions that affect their lives and equality of opportunity and treatment for all women and men.

Source: United Nations Environment Programme, *Green jobs: towards decent work in a sustainable, low-carbon world* (Nairobi, 2008), accessed from www.unep.org/labour_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Towards-Sustainable-Summary.pdf on 15 February 2011.

to be rapidly scaled-up to meet the emerging demands for skilled labour.

The ILO stresses that a "just transition" for workers and enterprises in support of the shift towards a low-carbon economy will provide workers affected by job losses with access to retraining and various forms of support and benefits, and must be based on social dialogue between government, industry and trade unions. Social justice and labour rights, including occupational health and safety, must be addressed.

A fair transition supported by inclusive policies should also take into account the present gender gap in economic activity, with women predominating in vulnerable and, especially, informal jobs. The new job opportunities created by green growth also present opportunities to fill the gender gap through targeted skills training. Targeting women, particularly those now in the informal sector, in skills training will help close the gender gap and improve poverty reduction efforts. Human capital formation for green growth should also target other vulnerable groups, especially youth. In South-East Asia, youth unemployment is 14.2 per cent compared to 3.0 per cent for adults.[66] Transitions should also benefit the people most directly affected by climate change, such as farmers and fishers.

Ensuring an inclusive transition should also include social assistance and welfare programmes to help the most vulnerable groups. Specific measures might include rebating new revenue to companies and consumers most directly affected by rising resource costs; phasing in tax shifts gradually and predictably; reducing or eliminating user charges for education and health services in the poorest rural and urban areas; providing cash transfers; and/or schemes that address vulnerability at the community level, such as micro- and agricultural insurance.

Conclusions

The choices that Asian and Pacific countries make during the next few decades are critically important for the future of the region and the planet. The region is rapidly becoming the world's dominant economic force and already contains the largest proportion of the planet's population. Overcoming the constraints and bottlenecks that impede the region's shift to a green economy must be seen as an imperative.

New financing approaches and incentives are needed to engage the private sector and the public in taking action. Changing the price structure and price signals to internalize economic values through eco-tax reform and other policy instruments is critical for building a green economy. Fears about creating new economic burdens and declining cost-competitiveness can only be dispelled through joint action by governments—international and regional cooperation is critical to the success of green growth.

The public is increasingly aware of the sustainability challenges faced. While environmental quality needs to be improved through enhanced environmental governance, the scale of the challenges faced will necessitate fundamental changes. Political leadership and strengthened efforts to create awareness of the issues and solutions will be needed. The green economy needs to be built on reoriented values and new skills and capacities to meet the burgeoning demand for green jobs. Education for sustainable development needs to be extended to all levels of society, from schools to on-the-job training.

One of the most difficult challenges to implementing green growth is the perception that the poor will pay for actions to promote it; for example, as ecological costs are internalized, energy and other prices increase. Thus, complementary measures are critical, especially in the context of eco-tax reform. In the transition to a green economy, people who lose environmentally damaging jobs need to be assisted through retraining and compensation. However, not all environment-related jobs offer adequate wages, safe working conditions and workers' rights. Green jobs, by definition, must also be decent—care must be taken to ensure that jobs created are safe and rewarding.

More fundamentally, a clear vision backed by a well-thought-out strategy and confident leadership is needed. Green growth represents major economic paradigm changes. No country has achieved this by itself, or can be expected to "go it alone." Emphasis needs to be placed on the quality of growth—poverty reduction and access to basic services for all, including disadvantaged groups; sustainable use of natural resources; health; education; decent jobs; a quality living environment; family relationships; and participation in society—in addition to the

incomplete present measures of human well-being, such as GDP per capita.

Quality of growth also will increasingly mean that resources are used to benefit the most disadvantaged people. In particular, emphasis needs to be placed on poverty reduction and access to basic services for all, including disadvantaged groups, particularly women. Technology can facilitate green growth, but is not a panacea. There is no "silver bullet" technology that will transform economies and solve all the challenges, but the Asian and Pacific region can become a global leader in many promising green economy technologies.

The policy approaches identified in this report are often impeded by vested interests in the status quo. Recognizing who stands to win and to lose is essential in crafting a consistent set of policies that will act in concert to achieve the necessary stepwise transition towards sustainable development. Multi-stakeholder processes, where all parties are engaged in framing workable solutions, are needed in all sectoral policy debates. Ultimately, however, vision and political leadership will be necessary to bring in the changes, along with a populace willing to accept and foster the changes.

These constraints and bottlenecks are balanced by tremendous opportunities for green growth, green jobs, and an improved quality of life and well-being for all citizens. Achieving the structural transformations needed during the next few decades in Asia and the Pacific will entail surmounting huge challenges. Long-term visions, matched by medium-term goals, are needed to ensure that stepping stones towards sustainable development are gradually being attained.

CHAPTER 4: GOVERNANCE FOR SUSTAINABLE DEVELOPMENT

Introduction

Over several centuries, a complex structure of governance has been created at the global, regional and national levels covering economic, social and environmental domains. Governance refers to the ways in which a society shares power, through structures and processes that shape individual and collective action.[1] Governance is not the sole purview of the State; it also emerges from the interactions of many actors, including the private sector and civil society.

Environmental governance has evolved as countries have exploited their natural resources and as understanding has increased about the scale and complexity of resulting environmental challenges. This evolution has resulted in the creation of new institutions and the development of concepts, approaches and mechanisms, including sustainable development, green growth and green economy. In this context, there has been a proliferation of political statements, multilateral agreements, and funding and governance mechanisms. A wide range of new stakeholders, from global to local, has found space and purpose, adding to the complexity and challenge of effective governance.

There is now a growing discourse around governance relating to the environment, green growth and green economy in the context

Box 4.1: Climate change: from science to policy and mainstreaming

Few environmental issues have had such an impact on governance, governments and all sectors of society and the economy as climate change. The governance changes associated with climate change stem from an unprecedented level of awareness and dialogue. The reasons for this are multiple and complex, but the starting point is the emerging scientific consensus brought to the attention of policy makers through the four extensive and rigorous reports of the Intergovernmental Panel on Climate Change (IPCC).[a] Concerns about potential climate change impacts have also found resonance with a wide spectrum of stakeholders, from the poorest communities (whose vulnerability is known to be high) to corporations and governments at all levels, many of which have incorporated the issue into their strategic planning.

This awareness has generated widespread pressure for change and has forced the rethinking and integration of many issues, such as energy production, biodiversity conservation and access, poverty, equity and rights, agriculture and ecosystems. Cross-sectoral coordination is increasingly seen in the mainstreaming of climate change into development plans, climate proofing of infrastructure, national action plans for climate change, new or restructured ministries dealing with climate change, and national councils on climate change, which are often located at the highest levels of government. Climate change has also catalysed research and investment into such areas as energy efficiency and renewable energy, and has helped stimulate economic growth and job creation in a number of green sectors.

[a] Despite recent questions, the Intergovernmental Panel on Climate Change (IPCC) process and reports have withstood scrutiny by independent experts, who made recommendations for improvement but found that, whatever the failings in certain aspects of IPCC's assessment process, the key findings remain unaffected. See InterAcademy Council, *Climate Change Assessments: Review of the Processes and Procedures of the IPCC* (Amsterdam, Committee to Review the IPCC, InterAcademy Council, 2010).

of sustainable development, which offers an opportunity for the global community to take stock of successes and failures in governance and address the main drivers of environmental change in new ways. For example, although the climate change issue still poses many challenges, climate change science is increasingly being mainstreamed into the policy domain (Box 4.1).

However, some fundamental constraints face the environmental agenda from the global to the local level. For instance, economic and social issues, which are most clearly associated with direct effects on people, often take precedence over environmental issues. Although a healthy environment is prerequisite for all human activity and well-being, environmental resources have traditionally been viewed as free public goods, owned by no one and most having little or no economic value or cost. Further, a lack of integration between strategies to address environmental, economic and social issues has contributed to the lack of implementation of sustainable development.

Governance strategies that build socio-economic resilience can provide an important opportunity to strengthen inclusive and sustainable development in Asia and the Pacific. The linkages between converging challenges (for example, food, fuel and water) imply that governance arrangements must increasingly promote cooperation, coordination and integration across previously disconnected economic, social and environmental domains. Establishing closer vertical linkages from global to local levels will also be important, as governance improvements at the global level are closely linked to good governance and policy implementation at the national level, and vice versa.

Global level governance

Current challenges

Global governance generally is said to have failed to adapt and evolve policies and institutions fast enough to keep pace with a rapidly changing and increasingly interconnected and complex world. A gap exists between current international institutions and arrangements and the changing economic and political realities.[2] The effectiveness of international environmental governance (IEG) has been under review in light of the continued deterioration of the environment and natural capital, despite continuing investments and initiatives to promote sustainable development and address environmental degradation.[3, 4]

The United Nations system is at the centre of IEG, including multilateral environmental agreements (MEAs), and associated implementation arrangements. Other key players include international financial institutions (IFIs), the private sector, the scientific community, intergovernmental and non-governmental organizations, civil society, other stakeholders and individuals.[5]

The shortcomings of IEG[6, 7] include weaker institutions than the more mature and longer-established institutions that make up the economic and social pillars of sustainable development, including a lack of adequate finance and compliance controls. The governance structure is also viewed as fragmented and uncoordinated, with a piecemeal and sometimes overlapping approach to environmental issues. This is illustrated by the more than 40 United Nations institutions with an environmental mandate. There are also now more than 500 MEAs of which approximately 323 are regional[8, 9] and their associated secretariats located in different countries. This results in high transaction costs and places a considerable burden on countries. There is also a nonalignment of policy and finance approaches, which is illustrated by the creation of a plethora of funds.

Outlook

The extensive consultative process to improve IEG has identified a number of system-wide responses to the challenges of the current system and a number of institutional options for strengthening the environmental pillar of sustainable development, namely:[10, 11]

- Enhancing the United Nations Environment Programme (UNEP);
- Establishing a new umbrella organization for sustainable development;
- Establishing a specialized agency, such as a world environment organization (WEO);
- Reforming the United Nations Economic and Social Council and the United Nations Commission on Sustainable Development; and

- Enhancing institutional reforms and streamlining existing structures. See for example some initiatives to improve the effectiveness and implementation of MEAs (Box 4.2).

The IEG proposals have been considered as part of the broader framework of sustainable development in the preparatory processes for the upcoming United Nations Conference on Sustainable Development (UNCSD or Rio+20).[12] The consideration of the institutional framework for sustainable development (IFSD) (Box 4.3) as one of the two major themes of Rio+20 presents an unprecedented opportunity to address the shortcomings of governance for sustainable development, including IEG. It also presents an opportunity to review the governance shortcomings of the economic and social pillars as well as the linkages between them.

The Solo Message issued by the High-Level Dialogue on IFSD, held in Solo, Indonesia from19 to 21 July 2011, underlined the need to ensure that economic, social and environmental pillars work together. It also highlighted the need for an organization to enhance integration at the international level. Options for enhanced integration were discussed in Solo, "ranging from an enhanced mandate for the ECOSOC and reviewing the role of the Commission for Sustainable Development, to the establishment of a Sustainable Development Council." The Solo Message also highlighted the need to strengthen UNEP.[13]

Box 4.2: Efforts to improve the effectiveness of multilateral environmental agreements

There has been recent progress in addressing governance challenges that countries face in implementing multilateral environmental agreement (MEA) commitments. The Montreal Protocol on Substances that Deplete the Ozone Layer is generally considered to be one of the most successful MEAs[a] because it has strong science-based, legally binding limits and equitable treatment of parties through, among other things, the Multilateral Fund, which is considered a key driver of success. Provisions that create incentives for compliance, readily available alternative chemicals, funding for less developed countries and a sense of common commitment and equity are considered equally important.[b] The Montreal Protocol can be regarded as an example of MEAs promoting green economic activity as an entire industry has developed based on the destruction and replacement of ozone-depleting substances.[c]

Other global initiatives to improve the management and implementation of MEAs include the following:

Clustering the chemical MEAs: The clustering of the chemical-related MEAs (the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, and the Stockholm Convention on Persistent Organic Pollutants) is a response to environmental governance shortcomings. There has been recent progress in pursuing joint management of these MEAs.[d] An analysis indicated that coordinated administrative arrangements among the three conventions alone would save up to $765,000 a year.[e] Enhancing cooperation and coordination among biodiversity-related MEAs may be a next cluster, where more systematic and effective support to the parties can be pursued.

The Green Customs Initiative (GCI) is a global programme to enhance the capacity of customs personnel to understand trade provisions relating to environmentally sensitive commodities covered by a number of conventions and MEAs, including the Montreal Protocol, the Basel, Rotterdam and Stockholm conventions, the Convention on the International Trade in Endangered Species (CITES) and the Cartagena Protocol on Biosafety. Partners include Interpol, the Organization for the Prohibition of Chemical Weapons (OPCW), the United Nations Office on Drugs and Crime (UNODC) and the World Customs Organization.[f]

Building capacity for MEA implementation: The European Commission has joined forces with the African, Caribbean and Pacific (ACP) group of countries, the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO)/United Nations Convention to Combat Desertification (UNCCD) Global Mechanism and other partners to enhance the capacity of developing countries to participate in the negotiation of MEAs and to implement them at the regional and national levels.

continued on next page.

Box 4.2 *continued*

Harmonization of MEA reporting: Work has been under way to reduce the burden on MEA parties by streamlining national reporting, with a focus on the biodiversity-related MEAs. A framework for core reports for the Convention on Biological Diversity (CBD), CITES, the Ramsar Convention, the African-Eurasian Waterbird Agreement (AEWA) and the Indian Ocean–South-East Asian Marine Turtle Memorandum of Understanding (IOSEA) was developed, as well as a joint report for the Convention on Migratory Species (CMS), AEWA and IOSEA. In Asia and the Pacific, a workshop in the Association of Southeast Asian Nations (ASEAN) subregion led to renewed calls for action in this area to convention secretariats, the ASEAN Secretariat, regional organizations and member States. The Government of Australia has also undertaken work in this area relating to the Pacific.[g]

A number of these initiatives are short-term, project-based activities that have limitations. Therefore, longer-term adjustments in governance mechanisms should be addressed at the earliest possible opportunity.

[a] United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Reduction – A Synthesis for Policy Makers* (Nairobi, 2011).
[b] United Nations Environment Programme, *Vital Ozone Graphics 2.0 Climate Link* (Nairobi, 2009).
[c] United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Reduction – A Synthesis for Policy Makers* (Nairobi, 2011).
[d] Parties agreed to establish an Ad Hoc Joint Working Group (AHJWG) on Enhancing Cooperation and Coordination Among the Basel, Rotterdam and Stockholm Conventions. Simultaneous Extraordinary Meetings of the Conferences of the Parties to the Basel, Rotterdam and Stockholm Conventions on enhancing cooperation and coordination (ExCOPs) were held in conjunction with the 25th session of UNEP's Governing Council/Global Ministerial Environment Forum (GC/GMEF) in Bali, Indonesia in February 2010. The outcomes included decisions on joint services and joint management (including financial, legal, information, information technology and resource mobilization), and joint activities and programmes, as well as coordinated activities by Parties and other stakeholders to implement synergies, including by strengthening national processes or mechanisms. See United Nations Environment Programme, *Simultaneous extraordinary meetings of the Conferences of the Parties to the Basel, Rotterdam and Stockholm conventions*, Bali, 22-24 February 2010 (UNEP/FAO/BC/RC/SC,2010), accessed from http://excops.unep.ch/outcomes/excops-outcomes.pdf on 7 August 2010.
[e] United Nations Environment Programme, *Simultaneous extraordinary meetings of the Conferences of the Parties to the Basel, Rotterdam and Stockholm conventions*, Bali, 22-24 February 2010 (UNEP/FAO/BC/RC/SC,2010), accessed from http://excops.unep.ch/outcomes/excops-outcomes.pdf on 7 August 2010.
[f] United Nations, Combating illegal trade in hazardous chemicals and wastes: cooperation through the Green Customs Initiative (GCI), in *Synergies Success Stories. Enhancing cooperation and coordination among the Basel, Rotterdam and Stockholm Conventions* (New York, 2011), accessed from www.basel.int/synergies/success_stories.pdf on 12 May 2011.
[g] Government of Australia and South Pacific Regional Environment Programme, *Streamlined reporting to the biodiversity-related multilateral environmental agreements* (Canberra, 2010), accessed from www.environment.gov.au/about/international/reporting/#about website on 14 February 2011.

The interface between trade and the environment is also the subject of increasing discussion, as governance of trade faces specific challenges in supporting a transition to greener growth and sustainable development. Currently, environment, trade and finance regimes may compromise each other's integrity, with measures enhancing one regime sometimes offsetting the effectiveness of the others.

One example is the conflicting principles between the World Trade Organization (WTO) and the Cartagena Protocol on Biosafety. In the WTO regime, any trade-restricting measure must be based on scientific principles and is not maintained without sufficient scientific evidence.[14] This conflicts with the reaffirmation in the Cartagena Protocol of the precautionary approach in Principle 15 of the Rio Declaration, which states that, "potentially dangerous activities can be restricted or prohibited even before they can be scientifically proven to cause serious damage."[15, 16]

One initial option to address such contradiction could be to encourage dialogue between stakeholders from these regimes to improve understanding and cooperation and identify the best available policy options for each regime. Another concern that has emerged recently, especially among developing countries, is that a green economy may result in "green protectionism" (Box 4.4).

Old and new sources of funding for environmental investments are also making a difference. The Global Environment Facility (GEF), the Adaptation Fund, the Green Climate Fund for long-term financial support of developing countries[17] and IFIs, such as the Asian Development Bank (ADB)

Box 4.3: The Institutional framework for sustainable development

The institutional framework for sustainable development (IFSD) "covers a spectrum of formal and less formal bodies, organizations, networks and arrangements that are involved in policy making or implementation activities" at local, national, regional and international levels.[a] At the 1992 United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil, in 1992, participants recognized that the effective institutional arrangements considered key to the implementation of sustainable development did not exist. Chapter 38 of *Agenda 21* set out the international institutional arrangements with the objective of "The overall integration of environment and development issues at the national, subregional, regional and international levels, including in the United Nations system institutional arrangements."[b] Subsequently, the Johannesburg Plan of Implementation (JPOI) formally presented IFSD and further defined international, regional and national roles and responsibilities.[c]

At the global level, the IFSD comprises institutions specializing in the environmental, economic and social dimensions of sustainable development. The United Nations General Assembly is the apex body for legislative outcomes on sustainable development; the Economic and Social Council has the overall mandate to integrate the three pillars of sustainable development; and the Commission on Sustainable Development is the high-level body responsible for the review and follow-up to the implementation of Agenda 21. The Commission has also taken the lead with respect to the involvement of major groups.[d]

Governance of the three pillars of sustainable development involves a number of institutions, including:[e]

- For the environmental dimension: the United Nations Environment Programme (UNEP), the numerous MEAs and associated financial mechanisms, notably the Global Environment Facility (GEF) and others, such as the Adaptation Fund for the Kyoto Protocol;[f, g]
- For the economic dimension: international financial and trade organizations, such as the World Bank, International Monetary Fund (IMF), the World Trade Organization (WTO) and the multilateral development banks; and
- For the social dimension: the International Labour Organization (ILO), the World Health Organization (WHO), the United Nations Human Rights Council and new institutions, such as the Joint United Nations Programme on HIV/AIDS (UNAIDS), and partnerships such as the Global Alliance for Vaccines and Immunization (United Nations Children's Fund [UNICEF], WHO, World Bank and the Bill and Melinda Gates Foundation).

United Nations regional commissions, and other regional and subregional institutions and bodies are key components of the institutional arrangements for sustainable development and regional implementation of Agenda 21.[h]

[a] United Nations General Assembly, *Objectives and themes of the United Nations Conference on Sustainable Development*, *Report of the Secretary General* (A/CONF.216/7 New York, 2011), accessed from www.uncsd2012.org/index.php?option=com_content&view=article&id=154:secretary-generals-report-on-objectives-and-themes&catid=72:preparatory-committees&Itemid=123

[b] United Nations, Agenda 21, Section IV, Chapter 38, International Institutional Arrangements (New York, 1992), accessed from www.un.org/esa/dsd/agenda21/res_agenda21_38.shtml

[c] United Nations, "Plan of implementation of the World Summit on Sustainable Development", in *Report of the World Summit on Sustainable Development*, Johannesburg, South Africa, 26 August-4 September 2002, A/CONF.199/20 (New York, 2002).

[d] United Nations General Assembly, *Objectives and themes of the United Nations Conference on Sustainable Development*, *Report of the Secretary General* (A/CONF.216/7 New York, 2011), accessed from www.uncsd2012.org/index.php?option=com_content&view=article&id=154:secretary-generals-report-on-objectives-and-themes&catid=72:preparatory-committees&Itemid=123

[e] United Nations Environment Programme, "Importance of environmental pillar to IFSD", in The environmental dimension of the institutional framework of sustainable development (IFSD), *Issue Brief* No. 1 (Nairobi, 2011), accessed from www.unep.org/environmentalgovernance/IssuesBriefsontheInstitutionalFramework/tabid/54126/Default.aspx on 14 June 2011.

[f] United Nations General Assembly, *Objectives and themes of the United Nations Conference on Sustainable Development*, *Report of the Secretary General* (A/CONF.216/7 New York, 2011), accessed from www.uncsd2012.org/index.php?option=com_content&view=article&id=154:secretary-generals-report-on-objectives-and-themes&catid=72:preparatory-committees&Itemid=123

[g] United Nations Environment Programme, "Importance of environmental pillar to IFSD", in The environmental dimension of the institutional framework of sustainable development (IFSD), *Issue Brief* No. 1 (Nairobi, 2011), accessed from www.unep.org/environmentalgovernance/IssuesBriefsontheInstitutionalFramework/tabid/54126/Default.aspx on 14 June 2011.

[h] United Nations, "Plan of implementation of the World Summit on Sustainable Development", in *Report of the World Summit on Sustainable Development*, Johannesburg, South Africa, 26 August-4 September 2002, A/CONF.199/20 (New York, 2002).

Box 4.4: Green protectionism

Green protectionism is the use of measures for protectionist ends implemented under the guise of addressing legitimate environmental goals. Voluntary or mandatory standards and eco-labelling are powerful tools for greening the economy, but they are also frequently cited as a concern in the context of green protectionism. Standards can be used as trade barriers to accessing lucrative export markets by developing country producers. There is a need to build developing country capacity in these areas so that they can take advantage of trade opportunities in growing export markets where standards and eco-labels play an important role.

The fear of loss of competitiveness is also present in developed countries, where domestic emissions standards and other regulations can raise production costs. As a result, goods produced in developed-country markets may become less price competitive than imports produced in countries with relatively lower emission and other environmental standards. Enterprises in developed countries have called for border tax or border carbon adjustments to level the playing field in this regard. There are doubts that emission standards and other regulations will affect competitiveness to the extent feared[a] and there are valid concerns regarding the practicality of measuring the carbon content of goods produced in foreign countries as a basis for assessing such a tax.[b] If deployed as a trade barrier and a tool for protectionism, border carbon adjustments are likely to have a negative impact on countires that are not members of the Organisation for Economic Co-operation and Development (OECD). Supportive measures should be put in place to enhance the competitiveness of goods and services provided by developing countries in an increasingly "carbon-constrained" market.

Another concern is about proposals for liberalizing the trade of selected climate- and environment-friendly goods and services, which have been submitted to the World Trade Organization (WTO) Committee on Trade and Environment.[c] The WTO Doha Round of negotiations has been considering removal of fisheries subsidies, non-tariff barriers on environmental goods and services, and agricultural trade liberalization, all of which could help stimulate more efficient and sustainable production.[d]

[a] See Hiau Looi Kee, Hong Ma and Muthukumara Mani, "The effects of domestic climate change measures on international competitiveness", *Policy Research Working Paper* 5309 (Washington, D.C., World Bank, 2010); Peter Wooders, Julia Reinaud and Aaron Cosbey, *Options for policy-makers: addressing competitiveness, leakage and climate change* (Winnipeg, International Institute for Sustainable Development, 2009); and Organisation for Economic Co-operation and Development, *The economics of climate change mitigation: policies and options for global action beyond 2012* (Paris, 2009).

[b] United Nations Economic and Social Commission for Asia and the Pacific, "Trade investment and climate change in Asia and the Pacific : Working together towards a triple win outcome" (Bangkok), unpublished.

[c] Economic and Social Commission for Asia and the Pacific, Asia-Pacific Trade and Investment Report 2011: Post-crisis Trade and Investment Opportunities. United Nations publication (Bangkok, 2011).

[d] United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Reduction – A Synthesis for Policy Makers* (Nairobi, 2011).

and the World Bank, are supporting environment and development governance. For example, over a decade ago, the World Bank established the Prototype Carbon Fund, which supports the Clean Development Mechanism (CDM) under the Kyoto Protocol. This fund pioneered the market for project-based greenhouse gas emission reductions while promoting sustainable development, and was instrumental in jump-starting the market for the CDM.

This example shows that any initiative needs a supporting financing mechanism to increase the chance of success. Achieving the necessary levels of investment would require political will, smart public policy, innovative financing mechanisms and national and international policy reforms.[18]

Another notable trend is the increasing importance of groupings of leading countries. On the economic front, the group of 20 leading nations (G20) is now supplanting the more restricted G8, in recognition that large rapidly growing countries, such as Brazil, China, India, Indonesia, Mexico and South Africa deserve a larger global "voice" in finding common solutions. At the September 2009 Pittsburgh Summit, held in response to the global financial crisis, the G20 even agreed to "move towards greener, more sustainable growth."[19] In addition, the Organisation for Economic Co-operation and Development (OECD), whose members represent about 80 per cent of the global economy, adopted a Green Growth Strategy in 2009 and published a series of related reports to support implementation.[20]

Other encouraging developments include the rise of global initiatives by private foundations and think tanks, such as the World Economic Forum (WEF), the expansion and influence of transnational corporations in greening industries and promotion of socially and environmentally sustainable corporate behaviour,[21] and the globalization of norms and standards (for example, environmental impact assessments covered by the International Organization for Standardization [ISO] Standard 14011 and, more recently, corporate social responsibility).

Given this momentum, the international community could further explore ways to link existing mechanisms and initiatives in the environmental and development domains, rather than create new governance structures and layers in an already crowded and complex governance landscape.

Regional level governance

Current challenges

The Johannesburg Plan of Implementation, outcome of the 2002 World Summit on Sustainable Development, mandates Regional Commissions of the United Nations to take specific steps to promote the integration of the three dimensions of sustainable development. ESCAP's role is complemented by subregional arrangements that also help to foster cooperation among countries.

The Association of Southeast Asian Nations (ASEAN) is seen as an emerging force, with its adopted Charter, progress on the ASEAN Free Trade Agreement, and other moves towards an ASEAN community by 2015. Since its creation in 1967, ASEAN has made considerable progress in building institutional mechanisms and processes for multilateral governance on the environment. Its structure now enables the shaping of common policies and the creation of common knowledge and information bases. The ASEAN Vision 2020 calls for "a clean and green ASEAN",[22] and the ASEAN Leaders' Statement on Sustained Recovery and Development, adopted in April 2010, documents the leaders' determination "to promote green growth, investments in long-term environmental sustainability, and sustainable use of natural resources in order to diversify and ensure resilience of our economy."

Other subregional institutions are the South Asian Association for Regional Co-Operation (SAARC), South Asia Cooperation in Environment Programme (SACEP), Secretariat for the Pacific Regional Environment Programme (SPREP), Tripartite Environment Ministers Meeting (TEMM) among China, Japan and the Republic of Korea, the North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC), and Interstate Sustainable Development Commission (ISDC) for Central Asia. Most of these are long-standing arrangements that are increasingly addressing environment, sustainable development and green growth issues in a more integrated way.

There are many other regional institutions, programmes, plans, activities and initiatives addressing regional environmental and sustainable development challenges initiated by governments, donors, United Nations agencies, intergovernmental organizations and international non-governmental organizations. One of the major outcomes of the World Summit on Sustainable Development in 2002 was the emphasis on regional implementation through partnership between governments and civil society. The political leadership voiced the need for the region to reach a common position through a policy dialogue. The establishment of a Subregional Environment Policy Dialogue (SEPD) was in response to this stated need. Seven policy dialogues have been held to date.

The Ministerial Conference on Environment and Development (MCED), convened every five years, has been a key regional forum bringing together policy makers and stakeholders to discuss sustainable development and green growth (Box 4.5).

Outlook

A sound, well-coordinated and coherent regional and subregional governance infrastructure that aims to address environmental and sustainability challenges effectively is essential for governing the region's rich and diverse natural resources and addressing shared challenges. Such a structure constitutes an important intermediate link between the global and national/local levels of governance and contributes to the adaptation of international policies to local contexts.[23, 24]

Regional cooperation can take many forms, including policy dialogue and initiatives, research on cross-border issues, regional capacity building and institutional strengthening, and regional

Box 4.5: The Ministerial Conferences on Environment and Development

The Ministerial Conference on Environment and Development (MCED) in Asia and the Pacific has been held every five years since 1985. This forum of ministers reviews progress on sustainable development, considers emerging issues, sets the high-level regional policy agenda on sustainable development and promotes a multi-year regional initiative on a priority concern. Initially targeted at ministers of environment, the participation has expanded to include ministers of finance and those responsible for development planning.

The discussions at the series of conferences reflect an evolution towards greater integration of environment-development issues. Whereas in 1995, regional cooperation on issues such as transboundary pollution, acid rain and marine pollution were highlighted,[a] the 2000 MCED in Kitakyushu, Japan, highlighted the need for concrete action to reverse the trend of continued environmental degradation, drawing lessons from the host city, which had successfully cleaned up its severe environmental pollution while maintaining economic livelihoods.

The 2005 MCED held in Seoul, Republic of Korea, pointed to the long-term risks posed by rapid and resource-intensive economic growth patterns as well as the rising demand for resources, and adopted green growth as a key strategy for sustainable development and achieving the Millennium Development Goals (MDGs). In 2010, the MCED in Astana, Kazakhstan concluded with a decision that governments would work together, to strengthen cooperation for the promotion of environmentally sustainable economic growth, or green growth, "as one of the prerequisites for attaining the Millennium Development Goals and sustainable development."[b] Influenced by the high-level policy agenda set for sustainable development through green growth, countries in the region as well as subregional groupings have taken the lead to identify green growth, appropriately adapted to country circumstances, as a key strategy for sustainable development.

The five-yearly interval between meetings means that meaningful changes can be identified by MCED in the sustainable development context and high-level policy agendas that respond to the changing context can be set. This relatively long meeting cycle contrasts with other ministerial forums, which usually meet on an annual or bi-annual basis.

Since 2000, each MCED has been followed up with the commitment of funds to support specific initiatives for action in the priority policy areas. This commitment to follow-up action is critical for translating high-level policy agendas to action on the ground. The Astana "Green Bridge" Initiative (AGBI) to promote a new Europe-Asia-Pacific partnership for green growth was endorsed by the sixth MCED in 2010. This initiative will receive core funding and direct support from the Government of Kazakhstan, which has established a Green Bridge Office to support its implementation. The programme of work of the AGBI will cover five thematic areas: eco-efficient use of natural resources and investment in ecosystem services, low-carbon development and adaptation to climate change, promotion of sustainable urban development, promotion of green business and green technology, promotion of sustainable lifestyles and improvement of quality of life.[c]

This example indicates that such high-level forums can be an effective means of building high-level political commitment and support for key challenges. At the same time, the forum could be strengthened through wider participation of civil society and other stakeholders in the preparations for the conference, the conference itself and in its follow-up action.

[a] *Report of the Ministerial Conference on Environment and Development in Asia and the Pacific* (E/ESCAP/MCED/Rep., 18 April 1996).
[b] *Ministerial declaration on environment and development in Asia and the Pacific, 2010* (E/ESCAP/MCED(6)/11, 20 October 2010).
[c] *Astana "Green Bridge" Initiative: Europe-Asia-Pacific partnership for the implementation of "green growth"* (E/ESCAP/MCED(6)/13, 20 October 2010).

partnership building through various regional forums and exchange programmes. Lessons from within and outside the region point to governance approaches that could promote cooperation, coordination and integration, thus addressing some of the shortcomings highlighted earlier.

Regional MEAs and implementation mechanisms can bridge the international to national levels, and translate international commitments to the regional and national levels. In addition to the initiatives presented in Box 4.2, other, ongoing regional efforts include:

- The Waigani Convention, an important vehicle to implement the Basel, Rotterdam (prior informed consent) and Stockholm (persistent organic pollutants) conventions in the Pacific subregion;
- The MEA Regional Enforcement Network (MEA-REN), a regional initiative that promotes cooperation among countries in North-East, South and South-East Asia with the aim of better control over transboundary movement of harmful chemicals and hazardous waste (for example, ozone-depleting substances, persistent organic pollutants, and electronic waste);[25]
- SPREP, which serves as the Pacific hub for efforts to build capacity for MEA implementation; achievements include raised awareness and improved national mainstreaming of MEAs and capacity building, including negotiating skills.[26]

Transboundary or bioregion-based plans and programmes are also important in dealing with governance of natural ecosystems or issues that cross national boundaries. Current challenges include dealing with serious transboundary air pollution and global climate change, managing cross-border rivers and protected areas, and controlling the transboundary movement of hazardous materials. Protecting regional and global public goods, such as transboundary air sheds or watersheds, biodiversity corridors, and shared marine and coastal ecosystems, requires coordinated regional or global action.

The Coral Triangle Initiative aims to protect a huge expanse of ocean ecosystems in the Indo-Pacific seas (Box 4.6) and is supported by high-level political commitments from the Governments of Indonesia, Malaysia, Papua New Guinea, the Philippines, Solomon Islands and Thailand. ADB serves as the lead agency of the GEF in organizing a programme of international technical and financial support to the initiative. To date, more than $300 million has been raised to complement government resources.

For terrestrial landscapes, well-defined networks of protected areas linked through biodiversity corridors are becoming a key strategy for managing the development potentials of those systems. As part of the Greater Mekong Subregion (GMS) programme, ADB is working to maintain and improve forest cover and biodiversity in priority conservation areas through the Biodiversity Conservation Corridors Initiative. The goal of the initiative is to maintain ecosystem connectivity across a broad ecological landscape by establishing eight biodiversity conservation corridors, covering 2 million hectares of forest area.

Other examples of regional plans and programmes include the Mekong River Commission and the UNEP regional seas programmes, which aim to address the accelerating degradation of the world's oceans and coastal areas through sustainable management and use of the marine and coastal environment, by engaging neighbouring countries in comprehensive and specific actions to protect their shared marine environment. In Asia and the Pacific, there are six regional seas programmes (East Asian Seas, North-East Pacific, North-West Pacific, Pacific, South Asian Seas and South-East Pacific).

Participation in formal mechanisms on transboundary issues is also vital. The major MEAs (United Nations Framework Convention on Climate Change [UNFCCC], Convention on

Box 4.6: The Coral Triangle

The Coral Triangle is the epicentre of the world's coral reef diversity. Also known as the "Amazon of the Sea", this ocean ecosystem holds more than 75 per cent of the known coral species and about 3,000 species of reef fish. Vital ecosystems in this area include coral reefs, mangroves and seagrass beds.

Unfortunately, the region is in danger from many threats, including coastal deforestation; wetlands reclamation for urban development, aquaculture and agriculture; land-based pollution; overfishing; and climate change, which have led to severe impacts on these essential ecosystems. For instance, 40 per cent of coral reefs and mangroves have been lost in South-East Asia over the past 40 years.

These changes already affect the 150 million people living in and around the coastal areas of the Coral Triangle, many of whom depend on healthy coastal ecosystems for provision of food, building materials, coastal protection, such industries as fishing and tourism, and many other benefits.

Source: The Coral Triangle Initiative Secretariat, accessed from www.cti-secretariat.net/ on 18 May 2011.

Biological Diversity [CBD] and United Nations Convention to Combat Desertification [UNCCD], in addition to the non-binding United Nations Forum on Forests) recommend actions to promote complementarity and synergy in seeking multiple environmental benefits, together with avoiding any trade-offs or negative impacts.

However, the performance of regional initiatives does not always match their aspirations, partly due to inadequate human resource capacity, insufficient funding, inadequate implementation periods, and lack of mainstreaming into economic development and poverty alleviation programmes. External funding of regional initiatives based on short-term projects (of 2-5 year duration) is of limited assistance in dealing with long-term challenges. It is essential that sustainability is built into project or programme design from the outset, in terms of both activities and impacts.

National and local level governance

Current challenges

Environmental management, sustainable development and green growth all require similar enabling conditions at the national level. Even in cases where the design of a policy is sound, intended results do not always materialize due to weaknesses in implementation arrangements. Avoiding this disconnect requires political will and leadership, strong and predictable public sector management systems, appropriate levels of funding and a governance environment that fosters transparency, accountability and stakeholder consultation.

Every sector faces challenges of governance and management. Some of these challenges are context specific, while others are more generic in nature and apply across sectors. These include power and vested interests, institutional inertia, varying interpretations and expectations by different groups, and a spectrum of risks associated with change. The incompatibility between short-term political thinking and the need for long-term planning and management of environmental resources is another critical factor that must be addressed.

Most governments in Asia and the Pacific have established institutional arrangements that address existing environmental challenges and have adopted comprehensive sets of legal and administrative frameworks to address the environmental impacts of rapid urbanization and industrial growth. Most are also Parties to major MEAs, including the UNFCCC, the Montreal Protocol on Substances that Deplete the Ozone Layer, CBD, UNCCD and the Basel Convention, to name a few.

As noted in Chapter 1, some countries in the region have gone further by developing new and innovative national legislation to promote resource efficiency, sustainable consumption and production, green growth and green economy. These include Japan's Fundamental Law and Plan for Establishing a Sound Material Cycle, China's Laws promoting Cleaner Production and also a Circular Economy, and the Republic of Korea's Framework Act on Low Carbon and Green Growth.

However, the effectiveness of national environmental protection programmes is, in many cases, severely hampered by limited institutional capacity, lack of technical expertise and insufficient funding. Environmental protection agencies continue to experience a shortage of personnel, particularly at the local level.[27]

A common institutional problem at the national level is that ministries in charge of the environment frequently have less influence than do powerful sectoral ministries, which are more predisposed towards unsustainable natural resource exploitation. In many cases, there is also poor coordination of developmental and environmental policies between different sectoral interests. Many of the legal instruments and strategies adopted by governments are largely sectoral in approach and are implemented by ministries interested only in the specific range of activities that fall within their mandate.

Thus, national ministries and regional and local agencies tend to work in relative isolation, although they often introduce policies and invest in projects that have major impacts on the responsibilities and work of other agencies. For instance, a ministry of energy or transportation may launch a major project for production of biofuel from solid waste without consulting the agency responsible for solid waste management.

At other times, more than one government agency may claim competence over a particular matter, resulting in overlapping jurisdiction and institutional rivalries.[28]

Outlook

In pursuit of sustainable development, improved governance and public sector management[29] national-level systems must include strong legal, regulatory and institutional frameworks, including arrangements for cross-sector coordination, sufficient human capacity, and sound public financial management (Box 4.7). High quality and effective administrative and management also requires transparent and merit-based recruitment, incentive structures to reward performance, systems to ensure accountability and ethical decisions, and staff development strategies. In countries or sectors where one or more of these elements is weak, the mainstreaming and implementation of sustainable development principles and/or environmental concerns are highly likely to be compromised.

National-level actions. Efforts to improve institutional development and capacity development at the national level must be broad-based. As a start, laws that promote sustainable development should provide a clear legal and regulatory basis for the key entities and policies that will drive reforms, and relevant agencies (environmental or otherwise) must also have clearly defined mandates, responsibilities and resources.

It is also advisable that efforts towards sustainable development strategies, including green growth, at the central government level be led and coordinated by the President or Prime Ministers' office, ministry of finance, or ministry of planning, with the ministry of environment playing an important role in providing technical inputs. Such an institutional arrangement would enable governments to position sustainable development at the centre of national decision-making and signal a level of commitment to the private sector to stimulate further private investments.

In some countries, this shift is already apparent in national approaches to climate change. China has included climate under the leadership of the powerful National Development Reform Commission; in India, the Prime Minister's Council on Climate Change coordinates the cross-governmental strategy, and a similar role is played by the President's office in Indonesia.

Box 4.7: Public financial management

At the heart of successful governance and policy reforms are sound systems for public financial management (PFM) that provide organization and management at all stages of the planning and budgeting cycle. Several PFM aspects are important in the pursuit of sustainable development and a green economy transition, particularly at the national level, including:

- Prioritizing government investment and spending in areas that stimulate the greening of economic sectors, such as subsidies with public-good characteristics and tax incentives to promote green investment;
- Limiting government spending in areas that deplete natural capital, such as subsidies that artificially lower the price of goods or reduce the profitability of green investments;
- Using taxes and market-based instruments to promote green investment and innovation, such as eco-taxes that provide a double dividend (taxing pollution while using the revenue to lower labour costs);
- Investing in capacity building, training and education to enhance administrative, technical and managerial capacity to seize new opportunities at the national level and prepare for possible economic restructuring.

PFM systems typically cover all steps in the budget cycle: budget preparation and formulation, budget implementation, expenditure control (budget implementation monitoring, internal controls and audit), accounting and financial reporting, auditing and external oversight.

Source: United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Reduction – A Synthesis for Policy Makers* (Nairobi, 2011).

Further, inter-agency cooperation is crucial for effective policy implementation. The implementation of sustainable development policies and programmes must involve several institutions besides those mentioned above. These may include those related to agriculture, industrial and economic development, energy, health and safety, natural resources management, land-use planning and transportation. In coordinating with other agencies, environmental agencies should address gaps and overlaps in authority and ambiguity in operational roles. Possible inter-agency cooperation mechanisms can include agreements that establish clear coordination procedures, joint research programmes, and multi-agency committees or task forces.

Local-level actions. Another trend affecting environmental governance is the granting of increased decision making to local or regional authorities in many Asian countries. For some functions, regional or local authorities have a more complete understanding of conditions and needs and can better respond to programme needs within a national framework. Thus, devolution and autonomy can foster increased efficiency and equity. However, there may be significant challenges in the transition. A common scenario is that local governments are given new responsibilities that they are unable to perform effectively due to lack of capacity and funding (so called "unfunded mandates"). The need is to strike a balance as to which responsibilities are retained at the national level and which are devolved to local levels.

From the local level up, transitions to sustainable development will require governance approaches that are inclusive and adaptive. (Box 4.8) Such approaches must involve addressing the region's governance challenges arising from multiple interests, inter-connectedness, rapid change, large uncertainties, and surprise.[30, 31, 32]

Fostering transitions to sustainable development through more inclusive and adaptive governance is not a narrow, prescriptive agenda. There are no institutional panaceas.[33, 34] Several important social trends that matured during the last decade have created opportunities for more inclusive and adaptive governance to emerge. Key trends include government decentralization reforms, increasing number and variety of civil society organizations and expanded access to information technology. The capacity for diverse actors to mobilize in support of innovative practices as well as mobilize against unsustainable practices has also grown tremendously.

To take advantage of these positive trends, attention to networks, multi-stakeholder processes (including social learning and deliberative processes) and action at different scales of government are all important.

Networks of people and organizations that go beyond formal administrative structures are increasingly recognized as important to learning and effective policy making and planning.[35, 36, 37] With better shared outcomes based on diverse perspectives and forms of knowledge, governments are increasingly realizing the power of networks in new policy areas and are changing their approaches to policy formulation and decision making (Box 4.9).[38]

Policy and programme integration is a recurrent and fundamental challenge in the pursuit of sustainability, especially since bureaucracies are often organized along ministerial lines. Multi-stakeholder processes that cut across government agencies and involve non-state actors can help evaluate and address integration challenges,[39] particularly where both losers and winners can be created by policies and initiatives. Inclusiveness is critical in exploring alternatives and making good decisions on development and management in complex situations. Social learning helps groups deal with informational and normative uncertainties, as well as empowering stakeholders to take adaptive actions and reduce conflicts.[40]

For instance, urban residents have responded to resource gaps and ineffective government by taking matters into their own hands, forming forums and civil society organizations that have addressed problems directly or pressured local government into addressing the problems.[41, 42] The Urban Resource Centre (URC) in Karachi, Pakistan, for example, developed an information base through which it can critique government plans and planning processes.[43] Members have been particularly active in pointing out how government plans fail to serve the interests of low-income groups, including those in the informal sector, and has also proposed alternative measures and policies.

An early and significant URC action was to challenge the Karachi Mass Transit Project. This resulted in modifications to the design as well as the extensions of the Karachi Circular Railway

Box 4.8: Inclusive and adaptive governance

Inclusive governance aims to ensure that the needs, interests and capabilities of disadvantaged and vulnerable groups are fully accounted for in the public decision-making process and in formulating suitable responses so that transition agendas are not captured by vested interests and so that decision makers are held accountable. Inclusiveness is also important for well-informed deliberation and decision making on strategies, policies and actions.

Different stakeholders have different roles in the economy. Moreover, they often have different beliefs, knowledge, experiences and understandings of complex issues. All of these may be of significance in pursuing and achieving transitions to sustainable development and a green economy. Stakeholders need to be able to question claims made about trends, and participate in identifying their causes and in formulating responses.

Opportunities can only be identified and then be acted on if stakeholders are encouraged to share their experiences and innovative practices. All components of society must be engaged in formulating actions and strategies and monitoring progress so that policies may be adjusted to adapt to changing circumstances as lessons learned from policy experiences arise.

Adaptive governance emphasizes learning, sharing responsibility and managing resilience or building the capacity to adapt.[a,b,c] It focuses on understanding and responding to the dynamics of the whole system, not just a few parts.[d] While governance systems in the Asian and Pacific region mostly remain centralized, expert-driven, compartmentalized, and inflexible, adaptiveness is emerging as a new requirement of a changing policy landscape. There can be both positive and negative unintended impacts of policy interventions and decisions, and these should be well understood and inform future policy making. The capacity of governance arrangements to capitalize on positive experiences and adjust policies and practices will depend on the extent that these arrangements can incorporate mechanisms for monitoring early warning signs and assessing the implications of emerging issues to guide proactive actions.

An important component of adaptive governance is the capacity to design and implement policies that are able to handle both anticipated situations and surprises.[e] Because it places emphasis on social networks that promote learning and self-organization, adaptive governance lowers costs of collaboration and conflict resolution, while still providing flexibility needed to adapt to changing circumstances.[f,g,h]

[a] C. Folke, T. Hahn, P. Olsson and J. Norberg, "Adaptive governance of social-ecological systems", *Annual Review of Environment and Resources* (2005) Vol. 30, pp. 441–473.
[b] C. Pahl-Wostl, "A conceptual framework for analyzing adaptive capacity and multi-level learning processes in resource governance regimes", *Global Environmental Change* (2009) vol. 19, pp. 345–365.
[c] United Nations Environment Programme, *Global environment outlook 4: Environment for development* (Nairobi, 2007).
[d] C. Folke, T. Hahn, P. Olsson and J. Norberg, "Adaptive governance of social-ecological systems", *Annual Review of Environment and Resources* (2005) Vol. 30, pp. 441–473.
[e] D. Swanson and S. Bhadwal, eds., *Creating adaptive policies: a guide for policy-making in an uncertain world* (London, Sage, 2009).
[f] C. Folke, T. Hahn, P. Olsson and J. Norberg, "Adaptive governance of social-ecological systems", *Annual Review of Environment and Resources* (2005) Vol. 30, pp. 441–473.
[g] L. Lebel, J.M. Anderies, B. Campbell, C. Folke, S. Hatfield-Dodds, T. Hughes and J. Wilson, "Governance and the capacity to manage resilience in regional social-ecological systems", *Ecology and Society* (2006) vol. 11, No. 1, article 19 (online), accessed from www.ecologyandsociety.org/vol11/iss1/art19/.
[h] C. Pahl-Wostl, "A conceptual framework for analyzing adaptive capacity and multi-level learning processes in resource governance regimes", *Global Environmental Change* (2009) vol. 19, pp. 345–365.

which together are acknowledged as a viable, cheaper and more environmentally friendly mass transit arrangement than the original proposal. The creation of alternative sources of information to the official ones, along with careful attention to communication, has widely expanded deliberation on important issues affecting the future of Karachi.[44, 45]

Legitimacy, stakeholder support and valuable information can be gained by constructive deliberations and the understanding they contribute to resolving policy problems. As such, deliberative processes can be highly complementary to traditional channels of policy advice, negotiation and decision-making.[46] They also set the stage for effective policy

implementation. Institutional mechanisms for coordination and cooperation in strategic policy and planning are needed to avoid conflicting policies arising, for example, from side effects of adaptation interventions.[47]

Inclusive and adaptive governance must be manifested at different scales of governance as a basis for achieving resilience, and is important to the response capacity of societies. While sustainable development and green growth require strong leadership and vision, as well as high-level national agencies to drive policy reform, such top-down approaches must be complemented by bottom-up approaches, as well as collaborative initiatives with other countries, in particular key trading partners, and at the regional level.

Local institutions and capacities for response are often critical for maintaining resilience and taking adaptive action. At the same time, monitoring and assessment must take place at all levels, and use different kinds of information. While local actors are often in a better position to monitor and assess the local impacts (beneficial and adverse) of national adaptation policies, national, regional and global institutions can support monitoring using aggregate indicators of resource use and socio-economic change. National institutions must also be prepared to put in place specific feedback loops so that the information provided and generated by local actors can be brought to bear on policy improvement. At the same time, national, regional and global institutions must be better prepared to receive and analyse information from actors at different levels in a meaningful way and without increasing administrative burdens.

Conclusions

As this overview has shown, governance in the context of sustainable development is characterized by complexity, fragmentation, uncertainty and change. Furthermore, transition towards green economic growth is a governance frontier and needs careful attention.

Developments at all levels provide valuable lessons to guide future governance decisions and directions. At the national level, one important message is that there is no blueprint for transition to a green economy that is applicable to all countries; each case requires individual analysis. Furthermore, environmental, sustainable development, green growth or green economy considerations should not be used as conditionalities to protect domestic industries from international competition. Countries must combine and balance environmental protection with safeguarding market access.[48]

Box 4.9: The Sustainable Penang Initiative

A recurrent theme in sustainability initiatives is that networks are very important to learning and securing progressive social and environmental change. The Sustainable Penang Initiative (SPI) developed a series of indicators for assessing sustainable development in the state of Penang in Malaysia.[a] Indicators were created through consultative roundtable discussions consisting of participants from government, academe, business and industry, youth groups, community groups and non-governmental organizations.[b] Stakeholders deliberated and agreed on a framework of 40 indicators. Their recommendations were used in formulating the Penang strategic plan for the next decade. Several other organizations were then formed, such as Water Watch Penang, and continue to contribute to building environmental awareness in the state.[b]

The SPI was successful in engaging people in discussing sustainable development and gained political support for development plans formulated through the process, because it had resources behind it, active civil society, and a state government that was open to inputs into strategic planning from a participatory process.[c,d]

[a] Asian Development Bank, Asian cities in the 21st century: contemporary approaches to municipal management. Vol. 4 Partnerships for better municipal management (Manila, 2000).
[b] T.P. Leng, "The Penang, Malaysia experiment in people, private, and public partnerships: process, progress, and procedures", Asia Pacific Perspectives (2005) vol. 5, No. 2, pp. 29–43.
[c] Asian Development Bank, Asian cities in the 21st century: contemporary approaches to municipal management. Vol. 4 Partnerships for better municipal management (Manila, 2000).
[d] A. Fazal, "The Sustainable Penang Initiative: Participatory and action-oriented approaches", Development (2009) vol. 52, No. 3, pp. 421–426.

In addition, governance approaches must account for the eventuality that there will be both winners and losers in the transition to green economies, especially in the short term. Thus, the transition must include education and skills programmes for qualified entrepreneurs and skilled workers to support job creation. Targeting women in these efforts can help close the gender gap and improve poverty reduction efforts. Further, ensuring a just transition should also include social assistance and welfare programmes to help the most vulnerable groups. Meanwhile, to help overcome long-term concerns that transitioning to a green economy will require additional costs, new approaches must demonstrate that these costs will be offset by reducing negative impacts, such as on the environment and health. These impacts are currently externalized and therefore hidden, thereby resulting in net savings rather than costs.

Furthermore, vertical integration from global to local levels is still lacking. The subsidiarity principle, with governance geared to the level of optimal effectiveness, is essential. Information flows to ensure that best governance practices are shared with communities and local governments, will help to bridge local and global aspirations for sustainable development. One important gap is a lack of comprehensive, credible research and analysis on which policies and institutional arrangements are or are not working and why. Monitoring and consideration of lessons learned and more adaptive governance would help the transition to green economic growth and sustainable development.

Furthermore, local initiatives are often more effective when supported by comprehensive national legislation and programmes. National agencies should make sure to provide the necessary oversight, implementation support and coordination to subnational entities, including policy guidance, staff training and establishing appropriate funding and reporting requirements.

Many of the challenges, barriers and issues relating to governance are shared, and in some cases the vision and examples of successful responses already exist. Inclusive and adaptive governance is one such example that deserves further attention. Strengthening governance requires much greater focus supported by appropriate resources, commitments and implementation capacity.

CHAPTER 5: STRENGTHENING RESILIENCE

Introduction

The policy- and decision making environment has become more uncertain and the number of people in the region who are exposed and vulnerable to environmental, economic and social change has significantly increased as risks have multiplied. As noted earlier, the world "faces ever-greater concerns regarding global risks, the prospect of rapid contagion through increasingly connected systems, and the threat of disastrous impacts."[1]

The extensive environmental changes being observed, the degradation of the quality of ecosystems and the potential scale of the projected impacts associated with climate change require not only greener growth, but also the need to manage for and strengthen resilience.

Resilience has emerged as an important reference point when discussing appropriate responses to the increasing levels of risk faced by societies and economies. First applied in relation to the study of ecosystems, the concept of resilience is now widely used to communicate the notion that a society or economy has the capacity to resist shocks and disturbances with minimal disruption.

Resilience may come from the strength of the society, economy or socio-economic system, but it also reflects "adaptive capacity" – the capacity to adapt to changing pressures and to self-organize in the pursuit of long-term outcomes. High levels of resilience mean that extreme stress, for example in the case of natural disaster or an extreme economic shock, can result in transformative change. As shown in Box 5.1, three factors help build resilience.

This chapter introduces the concept of resilience and describes how it can be applied to policymaking in a number of areas—agriculture, city planning, natural resource management, energy diversification and climate change adaptation.

Resilience and policymaking

A policymaking approach that promotes resilience takes into account that the future is not knowable and manageable.[2] Resilient economies need policies that can adapt to unanticipated conditions. Resilience concepts help explain the capacity of economies and societies to grow and transform successfully. Countries that are more resilient have a greater capacity to grow and transform successfully. For instance, countries with moderate exposure to risk (for instance, related to debt burdens in the financial, commercial and household sectors and to insurance of key economic sectors), a healthy capital stock, and high export diversification are well positioned to recover from economic and financial crises.

Policies and actions that promote environmentally sustainable economic growth can also lead to more resilient economies. A shift to greener growth can mitigate the impacts of adverse shocks by reducing the intensity of resource consumption, alleviating pressure on commodity prices and simultaneously fostering economic, social and environmental resilience. For instance, in the face of rising energy prices, a socio-economic system that has managed to decouple energy use from economic growth by using energy more efficiently will be able to withstand rising prices better than one that has higher energy intensity.

Box 5.1: Factors that build resilience

Robustness: the ability of a system to withstand a perturbation without significant loss of performance.

- Access to stocks of capital (all types)
- Infrastructure development (for example, distributed energy systems)
- Equitable income distribution
- Nature and diversity of relationships between socio-economic and environmental systems.

Redundancy: the extent to which different system elements can satisfy the same functional requirements; a diversity of pathways (or potential for creating a diversity of pathways) for achieving the same goal.

- Genetic and biological diversity (for example, diversity of, and within, functional groups of species (for example, pollinators, nitrogen fixers)
- Heterogeneity of landscapes
- Diversity and redundancy of institutions

Resourcefulness: the ability to diagnose, prioritize and initiate solutions to problems; the capacity for self-organization, where internal feedback influences development; the ability to combine different types of knowledge in order to cope with change and uncertainty.

- Institutions that balance power among interest groups
- Institutions and networks for learning and storing knowledge and experience
- Institutions that create flexibility in problem solving
- Opportunities for self evaluation and change—monitoring to generate and refine ecological knowledge and understanding into management institutions and action

Source: Adapted from K. Tierney, and M. Bruneau, "Conceptualizing and measuring resilience: a key to disaster loss reduction," in *TR News 250,* May-June 2007; C. Folke and others, "Resilience and sustainable development: building adaptive capacity in a world of transformation", scientific background paper on resilience for the process of the World Summit on Sustainable Development, on behalf of the Environmental Advisory Council to the Swedish Government (2002).

However, measures to achieve green growth may not be sufficient to ensure that economies and societies in the region will be well placed to cope and transform amid increasing uncertainty and risk. . "The concept of resilience shifts policies from those that aspire to control change in systems…to managing the capacity of social-ecological systems to cope with, adapt to, and shape change."[3]

Promoting adaptive capacity goes beyond developing within given boundaries of environmental capacity. A system is no longer sustainable if a sudden shock can push its functions or feedbacks permanently outside an acceptable range of performance. For instance, the pursuit of resilience extends beyond green growth in the important area of climate change adaptation, discussed further below.

Another important consideration for policymakers is the need to balance short-term measures meant to mitigate negative impacts of different shocks with long-term measures to build system resilience. Short-term considerations often prevail. In the agriculture sector, for instance, intensive monoculture systems can boost short-term productivity but increase the vulnerability of food supply to environmental change.

Similarly, shifting investments from social sectors, such as education, can hinder economies from recovering from economic shocks. Recent research has suggested that education in general, and female education in particular, can contribute significantly not only to poverty reduction but also to the building of a climate resilient region.[4] Gender equity is also essential to poverty reduction, improved living standards and sustainable economic growth.

Different forms of capital, therefore, are critical; developing and supporting natural and social capital can be just as important as boosting physical and economic capital.

Resilience in action

This section introduces three areas of actions and policies to illustrate how resilience can be applied to policymaking:

- Applying inclusive and adaptive governance approaches that better engage stakeholders in dealing with localized and evolving challenges;
- Diversifying and decentralizing energy pathways (including decentralized mixes of renewable energy technologies) to help expand energy services to underserved communities, while supplementing energy supplies to help avoid shortages due to rising energy demands (diversification is also vital in many other areas to ensure resilience, such as the industrial base and agriculture); and
- Pursuing a "no regrets" response to climate change as part of a broader effort to achieve inclusive and environmentally sustainable growth. Such a response represents sound development practice and confers benefits under a wide range of potential climate conditions.

Adaptive and inclusive approaches in agriculture, urban planning and natural resources management

As discussed in Chapter 4, adaptive policymaking leads to—and requires—different ways of thinking about governance, as complex solutions require negotiation and evaluation of management actions to deal with multiple interests, as well as large uncertainties about causes and impacts.

Recent experience with adaptive policymaking suggests that adaptive policies can be facilitated using tools that allow for integrated and forward looking analysis, multi-stakeholder deliberation and formal policy review. Outcomes of this approach include "automatic" policy adjustment, and decentralized decision making.[5]

Particularly when dealing with certain challenges, inclusiveness in governance also matters. Otherwise, the interests and capabilities of disadvantaged and vulnerable groups are likely to be ignored, leading to unfair allocation of burdens and risks, and benefits and opportunities. Measures to protect forests or watershed services, for example, by excluding traditional users, if not adequately compensated, could increase their vulnerability to economic shocks by removing crucial livelihood options.

Some of the trends identified in Chapter 1, such as growth of civil society, expanded access to information technology and the rise of environmental protection on government agendas, have created opportunities for more inclusive and adaptive governance. Three examples are provided below.

Managing climate risks in agriculture. Farmers often have substantial experience with managing risks arising from natural climate variability, which is central to achieving food security and rural economic development. More than others, they also understand how other factors, such as soil conditions, water availability, access to commodity markets, technologies and credit, as well as debt burdens, constrain their responses.

Changing attitudes and new forms of communication, reflected in policy and research agendas, will be vital to produce new and actionable knowledge that brings together this practical knowledge with scientific understanding about likely future risks due to climate change and possible adaptation responses.[6] Communities will need access to climate information; actors at higher levels should ensure that adaptation responses address local stakeholder concerns. Adaptation strategies should build on and sustain existing livelihoods and take into account the existing knowledge and coping strategies of the poor. In this regard, adaptive approaches that support learning[7] and reversible or flexible options[8] are likely to be crucial.

Institutional innovations that bring close engagement of researchers with farmers will allow a better understanding of the risks faced, information required and the ability of science to support risk management.[9],[10] Some research and development models in agriculture pay substantial attention to brokering, often institutionalizing the links between farmers and researchers so that there is high-quality two-way communication. This is in contrast to the linear model of transferring research from laboratory to field station to farmers, which is not sufficient to deal with the complexity of issues involved in climate adaptation.[11] This remains true even as advances in information technology create improved opportunities to deliver timely information on weather and prices.

Engaging stakeholders in the pursuit sustainable cities. Economic forces, demographic change and, increasingly, environmental challenges play major roles in the development of cities. Planning and environmental regulatory agencies typically struggle to keep up with land-use changes and end up relegated to undertaking corrective measures to deal with the negative impacts of urbanization.[12] Participatory forms of urban governance have emerged in cities even where public participation in national decision making, political representation and accountability of authorities is constrained by socio-cultural, institutional and political factors.

The advance of information technology has allowed civil "movements" that respond to perceived threats to start and spread quickly. A government's institutional capacity to manage the resulting information and deliberation and effectively negotiate a mutually acceptable and effective solution will determine whether urban development initiatives that support sustainable and inclusive development will be facilitated or social conflict will result. Institutional innovations can support stakeholders in defining effective solutions to improve their resilience. For instance, the "Baan Mangkong" national slum upgrading programme in Thailand supported efforts by community organizations to come up with their own solutions to land and housing problems (Box 5.2).[13]

Managing natural resources with local users. Local management of natural resources is an important element of maintaining the resilience of social-ecological systems as state agencies do not always have the knowledge, reach or skills necessary to be effective for across all communities and ecosystems.

Box 5.2: The Baan Mangkong programme

In Thailand, a national slum upgrading programme and implemented by the Community Organizations Development Institute (CODI) under the Ministry of Social Development and Human Security, was launched in 2003. Through this programme, many organizations founded savings groups and negotiated with landowners to obtain and secure land for collective use.

CODI acts as an important broker working with many other stakeholders, including local non-governmental organizations (NGOs), local government, and international NGOs, to do surveys and help select and finalize projects, and then oversee infrastructure subsidies and housing loans provided directly to communities. CODI operates a revolving fund from which it can make soft loans. In addition to financing, it has also worked to resolve conflicts.

As of March 2008, 512 projects valued at approximately $98 million had been financed in 1,010 communities affecting about 54,000 households.[a] Some projects entailed refurbishing sites, while others involved relocation and reconstruction, thus creating more opportunities for new collective planning and infrastructure. CODI was able to intervene successfully between government authorities that owned land and informal settlements on canal waterfronts in Bangkok to help resolve conflicts and improve living conditions.[b]

Local NGOs and their strong local community networks also played a crucial role in securing tenure for the settlers and implementing upgrading projects. Where relocation is involved, compensation and security of tenure are important to project success but need to be followed up with support for social welfare and community development.[c]

The overall process was a significant step towards decentralization to local authorities and empowerment of local communities, as the projects are largely planned and implemented locally. The creation of a more flexible financing mechanism was also important to the projects' success. The slum upgrading programme, which was the result of a learning process with local community organizations that had spanned at least 30 years,[a] is an example of coordination across levels of governance.

[a] S. Boonyabancha, "Land for housing the poor by the poor: experiences from the Baan Mankong nationwide slum upgrading programme in Thailand", *Environment and Urbanization* (2009) vol. 21, pp. 309–329.
[b] N. Usavagovitwong and P. Posriprasert, "Urban poor housing development on Bangkok's waterfront: securing tenure, supporting community processes", *Environment and Urbanization* (2006) vol. 18, pp. 523–536.
[c] V. Viratkapan and R. Perera, "Slum relocation projects in Bangkok: what has contributed to their success or failure?" *Habitat International* (2006) vol. 30, pp. 157–174.

Adaptive co-management has emerged as one of the more promising approaches to integrating conservation objectives with sustainable use of natural resources in ways that enhance local social-ecological resilience.[14, 15] Learning and collaboration are its two main pillars.[16] Co-management activities learn from past interventions and are flexible in updating rules using newly available knowledge.[17]

Co-management is particularly suited to complex social-ecological systems where there is a long-standing imperative to improve the linkages between institutions and the social and ecological dimensions of a problem.[18, 19] In dealing with complex problems where cause-and-effect relationships and future dynamics are uncertain, trust needs to be developed among stakeholders so that when new circumstances demand changing practices, stakeholders are willing to deliberate and negotiate the next steps.[20]

As an example, in Aceh, Indonesia, an agreement between the water utility in the Aceh River watershed and two communities provides payments for reducing illegal logging. The management of the water utility has expressed the intention to expand this payment for ecosystem services (PES) arrangement to funding other watershed management activities, should the agreement effectively address the most immediate threats to the water supply.[21]

The challenge of water security, along with its relationship with food security and land use, presents a highly complex management environment, with significant uncertainty and many stakeholders. Meaningful multiple stakeholder participation is critical for exploring alternatives and making good decisions about water resource development and management in complex situations, such as regional and transboundary waters. Dialogues may contribute to reducing water conflicts, ensuring equitable and fair allocation and promoting ecologically sustainable use and management. Dialogues may also inform and help shape more formal negotiation and decision making processes by bringing in a wider range of perspectives on needs, impacts, and options, and having them deliberated openly.[22, 23]

This will require change from water bureaucracies built on highly technical, top-down management that emphasizes large-scale technologies.[24, 25] Commitments to integrated water resources management have opened some opportunities for wider engagement, such as consultation processes mandated by some river basin organizations as part of their normal business.

Diversifying and decentralizing energy systems

Energy access, affordability and quality continue to be important issues in developing Asian countries. As discussed in Chapter 1, fossil fuel dependence exposes countries to price and supply fluctuations that can undermine their economic stability and raises concerns about energy security.

In broad terms, the possible responses to these concerns can be grouped into two categories. One path aims to preserve the status quo by continuing to support resource-intensive private transportation, ensuring uninterrupted fossil fuel supply, and providing massive subsidies for petroleum-based fuels. The other path involves directing energy infrastructure towards more efficient and diversified energy systems, which also aligns with the climate change agenda.

Driven largely by energy security concerns, many countries are increasingly choosing the latter pathway, including promoting renewable energy. For instance, the Renewable Energy Law (2006) in China aims to boost renewable energy capacity to 15 per cent by 2020 and outlines a commitment to invest $180 billion to accomplish that goal.[26] Many other countries in Asia and the Pacific have similar targets to demonstrate their support for renewable energy as a means to diversify energy supplies and enhance the resilience of energy systems. For example:

- Indonesia's renewable energy programme is driven by its need to diversify its supply of fuels. The country aims to diversify its energy from the current mix, while expanding renewable energy to 17 per cent by 2025 (from 2 per cent in recent years); [27]
- India is using renewable energy to provide decentralized power generation to improve access to electricity in rural and urban areas. By 2032, the country hopes to have 15 per cent of its power capacity based on renewable energy, 10 per cent of oil use substituted by biofuels and synthetic fuels, and enhanced use of solar hot water; [28]

- Viet Nam, under its strategy of National Energy Development, aims to diversify into renewable energy resources, utilize them in remote areas, and increase the share of renewable energy to 11 per cent by 2050; [29] and
- Malaysia has set a renewable energy target of 10 per cent of the total electricity generation mix by 2010 as a part of its New Five-Fuel Diversification Strategy, adopted in 2001. Its earlier Four Fuel Strategy helped reduce oil consumption for power generation from more than 80 per cent in 1983 to 2 per cent in 2008; [30]

The potential success of implementing a more diversified pathway, along with specific policies and programmes, varies across countries depending upon energy resource endowments, as well as technological and institutional capabilities. Nevertheless, prospects for renewable energy are generally trending upward. Analyses by the World Resources Institute conclude that, on a real cost basis,[31] biomass power and onshore wind are already competitive with coal and natural gas, and solar photovoltaic energy is projected to be competitive by 2012.[32]

While renewable energy generally has higher up-front capital costs, it also has lower operating and maintenance costs, including zero fuel cost for some resources (for example, solar energy and wind; biomass power using agro-processing waste; biogas digesters for recovering energy from wastewater). For geothermal and landfill gas, the "fuel cost" is capitalized up-front in the form of drilling for steam and gas extraction, respectively.

Financing can be often more effectively used for distributed generation, which provides prime power at the point of use (including co-generation and tri-generation systems), than for expanding national grids with centralized power generation, which commonly suffer from high system losses (Box 5.3).[33] Further, distributed or decentralized systems have some inherent resilience to catastrophic events, such as earthquakes and typhoons, as a single extreme event is unlikely to disable an entire network of distributed generation plants.

Governments across the region are taking steps to improve the feasibility of renewable energy. Some of the most common measures include establishing feed-in-tariffs (FITs) and creating renewable purchase obligations (RPOs).[34] Thailand has channelled private investment into renewable energy through FITs. Consequently, the number of "very small power producers" using biomass and other renewable energy resources has increased remarkably. The reclassification of "very small" (from less than 1 megawatt [MW] capacity to less than 10 MW capacity for the purpose of using the tariffs) has contributed to

Box 5.3: Decentralized and distributed energy generation

While conventional, centralized infrastructure is still necessary, modular and decentralized services may be more appropriate in some cases, especially when funding constraints exist. This design approach is being taken for second-generation concentrating solar power, which has yet to be proven at a large scale;[a] for next-generation nuclear power plants, which are still pre-commercial; and for residential buildings, where the embedded energy can be significantly reduced compared to conventional construction. The financial and economic viability of decentralized and modular infrastructure will vary across sectors and projects, but the traditional economies-of-scale logic needs to be calibrated to the availability of financing.

In poor rural areas, distributed generation systems using traditional biomass feedstock, such as animal wastes and woody biomass, are a logical application for delivering reliable energy services. Biomass cogeneration in agro-industrial estates is an obvious win-win solution compared to fossil-based grid-supplied power and on-site petroleum-based boilers.[b] Other low-cost options for basic services include hand-cranked light-emitting diode (LED) and solar photovoltaic lighting. In addition, methane mitigation, for example, via loss reduction programmes for the ageing gas pipeline networks of Central Asia, typically pay for themselves within a few years.

[a] For example, see the technology and project summaries in eSolar, *Scalable solutions for the global CSP market*, accessed from www.esolar.com on 21 May 2011.
[b] Dozens of biomass cogeneration plants at agro-industrial estates in Indonesia and Malaysia have been installed and registered as Clean Development Mechanism projects. These plants utilize waste biomass that was previously dumped on the ground or in adjacent streams and rivers. The environmental benefits of these cogeneration plants are obvious compared to fossil fuel-based grid-supplied power.

the success, along with technical assistance and advice from small and medium-sized enterprises and the country's political stability. Thailand's success can be replicated in other countries, but such measures as FITs and RPOs must be carefully adapted to specific country contexts.

One of the most innovative initiatives to promote renewable energy and energy efficiency simultaneously—which should be emulated considering the growing urbanization and need for housing—is the introduction of net metering (Box 5.4).

Developing countries in the region could also consider promoting second-generation biofuels, which can potentially help diversify a country's energy mix without the significant trade-offs sometimes experienced in first-generation fuels. Second-generation biofuels can be produced from residues of forests and agriculture, energy crops, and organic municipal solid waste. Thus, they could have relatively smaller impact on food security and also a relatively smaller carbon footprint. Their use could also further reduce the cost and increase the availability of feedstocks, while improving the efficiency of biofuel processing as technologies mature. However, care must be taken to ensure that the promotion of second-generation biofuels is pursued in tandem with sustainable forestry and agricultural practices.

Pursuing a "no regrets" approach to climate change adaptation

Resilience has become an important concept in the global dialogue on climate change, featuring prominently in successive reports of the Intergovernmental Panel on Climate Change (IPCC). In the context of climate change, the IPCC Fourth Assessment Report describes resilience as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization and the capacity to adapt to stress and change.[35]

Every country of the region, every sector of activity, and every community will be affected by climate change. As a whole, these changes are expected to be of an adverse nature. While the inability to predict future changes in climate variables accurately (especially so at local levels) adds to the difficulty for initiating adaptation efforts, the projected impacts of climate change are not hypothetical. Indeed, climate projections (mostly of temperature and rainfall patterns) for the next 40 to 50 years do not depend on existing and future emissions of greenhouse gases, but on past emissions and the resulting stock of these gases in the atmosphere. Similarly, sea level will continue to rise over the coming century regardless of the quantity of greenhouse gases that will be emitted over the same period of time. To this extent, the world is committed to some climate change, and many early manifestations of climate change are already visible in the region.[36]

With its large populations, especially in coastal areas, Asia and the Pacific is particularly exposed to these projected changes, with the poor most at risk. Poor communities often have few assets to help cope with disaster losses, and the loss of scarce assets to natural disasters has a particularly damaging effect on their well-being. Disasters can rapidly erase accumulated development

Box 5.4: Net metering

With net metering, the consumer generates electricity at the point of use, and is able to supply excess electricity generated into the grid, either earning revenue or reducing net payable consumption. Net metering provides a regulatory basis for distributed and decentralized energy systems and at the same time provides a powerful incentive for end-use efficiency improvements. Net metering can be combined with feed-in-tariffs to promote renewable energy generation in decentralized applications.

For example, the Philippines' Renewable Energy Act of 2008 (considered to be the most comprehensive renewable energy law in South-East Asia) includes a net metering scheme that will allow consumers to sell power to the grid at an approved feed-in tariff and buy power as necessary at the normal retail tariff. The feed-in tariff will provide a guaranteed fixed price for at least 12 years for electricity produced from emerging renewable resources (wind, solar power, ocean, run-of-river hydropower, and biomass).[a]

[a] Congress of the Philippines, Fourteenth Congress, Second Regular Session, "Republic Act No. 9513, Renewable Energy Act of 2008", 28 July 2008, accessed from www.senate.gov.ph/republic_acts/ra%209513.pdf on 30 March 2011.

progress achieved with great effort over previous decades. Climate change is expected to "turbo-charge the disaster risk-poverty nexus, drastically increasing disaster impacts on the poor and resulting poverty outcomes."[37]

Certain impacts of climate change, including the loss of high-altitude glacial and snowpack storage and sea-level rise, are deemed to be very likely, although there may be uncertainty with respect to their timing. The uncertainty around many other aspects of climate change, including seasonal rainfall patterns and the frequency and magnitudes of extreme events, is much higher. It may be impossible or unwise to utilize projections of these variables as an explicit basis for design unless there is a high degree of coherence across projections, and unless projections are required to guide design, as in many water resources and agricultural adaptation activities, where risks are high (Box 5.5).

Some types of possible events associated with climate change require a fundamentally different conceptual approach. Those are events with extremely low (or even completely unknown) probabilities but with immense consequences if they were to occur. The collapse of the West Antarctica ice sheet is an example of such event. Events of this nature require long-term considerations with respect to regional integration and institutional design, and in particular to address the social and political stresses that will invariably accompany uncertain and potentially catastrophic circumstances.

The capacity to deal with these various risks (different in nature and in likelihood), to adapt to climate change and to withstand and recover from natural hazards (including hydro-meteorological hazards) varies from country to country, and from locality to locality. Such capacity obviously depends on the extent to which policies foster preparedness (for example, early warning systems and flood control); the extent of investments in contingency planning and response capacity; and the extent of spreading risk through insurance policies for natural disaster management. Such capacity also depends crucially on socio-economic factors, such as income and education.

Box 5.5 : Threats from climate change to food and water security

In combination with current land degradation trends, climate change poses a major threat to the region's food and water security. The extensive reliance of many economies of the regio on agriculture and resulting competition for water and land resources, exposes them to significant risks from increased climatic variability, in particular floods and droughts.

A recent study by the International Food Policy Research Institute (IFPRI) and Asian Development Bank (ADB) projects a decrease in cultivable area for most staple crops, leading to large decreases in overall production when combined with yield impacts.[a] This will result in larger increases in the prices of staple commodities than under baseline assumptions. In turn, price increases are likely to lead to reduced consumption and increased malnutrition.

Water, along with agriculture, has been identified as the sector "most sensitive to climate change-induced impacts in Asia."[b] Adaptation requirements will be extensive. ADB has recently estimated the investment needs for water and sanitation in Asia and the Pacific over 2010-2020 at roughly $35 billion/year, including both new capacity and replacement of capital stock.[c]

Adaptation approaches include significant expansion of storage capacity (both surface and groundwater), improvements in water use efficiency (particularly in irrigated agriculture), re-allocation of water between sectors, reuse and recycling of wastewater, and a wide range of aggressive demand management measures. There is no substitute for water, although some countries may be able to manage structural water deficits through trade in embodied ("virtual") water.[d]

[a] International Food Policy Research Institute (IFPRI) and Asian Development Bank (ADB), Building climate resilience in the agriculture and food sector of Asia and the Pacific (Manila, ADB, 2009).
[b] Intergovernmental Panel on Climate Change (IPCC), Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Geneva, 2007).
[c] Asian Development Bank and the Asian Development Bank Institute (ADBI), Infrastructure for a seamless Asia (Tokyo, ADBI, 2009).
[d] See for example, D. Wichelns, An economic analysis of the virtual water concept in relation to the agri-food sector (Paris, Organisation for Economic Co-operation and Development, 2010).

In this regard, approaches to climate change adaptation must span a continuum of responses, from those that are entirely justified by specific impacts on specific locations to those that represent sound development practice and confer benefits under a wide range of potential climatic conditions, even in the absence of climate change. The latter "no-regrets" approach can deliver outcomes appropriate to a wide range of opportunities, function effectively in a wide range of conditions and provide high level of security and confidence.

There are several guiding principles that are applicable over the full continuum of adaptation requirements. This suggests that adapting to climate change should be viewed as just one part of a broader effort to achieve inclusive and environmentally sustainable growth. Some of these principles are discussed below.

Keep the focus on development and poverty reduction. While economic growth must take a different path towards green growth, economic development remains key to achieving resilience in the context of climate change. There is a corresponding opportunity to review the development process in a way that de-emphasizes "growth" as generally measured by changes in the economic value of goods and services produced by an economy over a finite period of time, and gives new emphasis to the factors that underlie dignified, meaningful and resilient lives and livelihoods.

Resilient societies are not only wealthy societies, but also healthy, well-educated, politically empowered, and capable of enjoying a reasonable degree of physical and economic security. In particular, an Asia and Pacific free of poverty will be a region which is considerably more resilient to climate change, regardless of what these changes may be. By prioritizing the needs of the poor and by identifying opportunities to build the resilience of poor and marginalized communities through their adaptation efforts, policymakers can address the root causes of poverty.

Use sound science and forecasting. New and improved technologies are becoming increasingly available and affordable to integrate concerns about climate variability[38] into agriculture and food security, water resources management, health and disaster management. Innovations in climate science, such as climate forecasting and satellite-based monitoring, are improving decision making in these areas.[39]

Improving the capacity to forecast climatic events and to use sound science to respond to forecasted events will deliver immense benefits to the users of climate information regardless of the specific nature of changes in climate variables. Seasonal forecasting provides opportunities to manage climate impacts one season ahead, and it could be applied much more effectively by tailoring it better to users' needs.[40] As discussed above in the section on "Inclusive and adaptive governance," such measures should build on existing local capacities, knowledge, and institutions to enable greater resilience to seasonal and inter-annual climate variability. This requires inclusiveness in decision making to ensure that projects and policy interventions are sensitive to the interests of the rural poor.

For instance, Nepal is currently implementing projects under the Pilot Program for Climate Resilience (PPCR) to support digitization of its hydro-meteorological database and to down-scale the data for local planning and capacity development of stakeholders to respond to climate risks.[41] In New South Wales, Australia, climate forecasting investments are beginning to be used by pastoralists to influence buying and selling decisions.[42] In the short term, this allows them to build capital (and so enhance "robustness," see below), thereby improving their ability not only to respond to short-term crises, but also to take decisions regarding their stock that are better suited to changing market conditions.

Strengthening the resilience of national response mechanisms and contingency plans is also important. This should include not only the capacity of national agencies to respond to extreme weather events, but should also include understanding the risks to critical national infrastructure and key environmental assets.

Incorporate ecosystem-based approaches in adaptation strategies. Climate change will have profound negative impacts on natural ecosystems. Important impacts include increased susceptibility to pests and diseases, loss of species diversity and loss of important ecosystem services, including (critically) carbon sequestration.[43] These will add considerable stress on all ecosystems, particularly those already significantly degraded. It was noted in Chapter 3 that protecting, restoring and investing in ecosystems are key to achieving green growth and to achieving resilience in the context of climate change.

Activities that restore and protect biodiversity can be important components of broader climate change adaptation strategies as well as delivering social and economic benefits regardless of their climate change adaptation benefits.

Such ecosystem-based approaches to adaptation, including sustainable management, conservation and/or restoration of critical ecosystems, can generate substantial economic and cultural co-benefits in addition to preserving and enhancing ecosystem functions, and should be exploited as cost-effective approaches for establishing societal resilience. For instance, protecting or planting new mangrove plantations can help mitigate the impacts of sea-level rise and storm surges, as well as improve the effectiveness of upstream wetlands in attenuating downstream flooding. Other opportunities are provided by reforestation and agroforestry activities that create both sustainable livelihoods and environmental services, including water quality management and carbon sequestration in addition to direct ecological benefits.

Risk sharing through insurance schemes. Insurance schemes, while contributing to adaptation to climate change, are key to reducing vulnerability to climate variability, regardless of the nature and extent of this variability. Index-based micro-insurance policies have been pilot tested in Ethiopia and India. This type of policy is specifically tailored to poor farmers who were previously not considered insurable.[44] A summary of the experience in India is presented in Table 5.1.

Conclusions

Policymakers face considerable challenges in managing the growing risks related to the supply of resources and environmental change. The large numbers of vulnerable people and the scale of projected and ongoing economic impacts of environmental change, including climate change, have led not only to discussion about the need for greener growth, but also the need to build resilient economies and societies. Greener

Table 5.1: Elements of adaptive policies in crop insurance in India

Type of Insurance	Ability to adapt to anticipated conditions		Ability to adapt to unanticipated conditions	
	Design	Implementation	Design	Implementation
Traditional	Low - can help farmers deal with a range of weather conditions but fails to provides the right incentives as yields are insured irrespective of efforts	Low - high administrative costs and long delays in claim settlements - failed in terms of coverage of farmers and financial sustainability	Low - poor understanding of interaction with natural, built, or social environments	Low - no formal or informal mechanisms for learning and adjustment
Weather-indexed	High - protects the farmer's overall income rather than the yield of a specific crop - moral hazard and claims manipulation eliminated by use of objectively calculated index	High - quick payouts triggered by independently monitored weather indices can improve recovery times and enhance coping capacity	High - use of rolling means to calculate precipitation thresholds allows for automatic response to unpredictable climate change while maintaining simplicity and transparency	High - implemented on a pilot basis by trying out different types of delivery models with formal process of monitoring, learning - feedback from engagement of local institutions and improvement

Source: The Energy and Resources Institute, the International Institute for Sustainable Development, and the International Development Research Centre, *Designing Policies in a World of Uncertainty, Change and Surprise: Adaptive Policy-Making for Agriculture and Water Resources in the Face of Climate Change, Phase 1 Research Report* (Energy and Resources Institute and the International Institute for Sustainable Development, Delhi, November 2006).

growth contributes to greater resilience in several ways; however, building resilience implies specific strategies, including a focus on strengthening adaptive capacity.

Resourcefulness, redundancy and robustness are key attributes of societies that are resilient to economic, social and environmental shocks. These attributes can apply to many areas of public decision making, and numerous actions and policies can contribute to their achievement.

Greater resourcefulness can be achieved by pursuing governance approaches that account for greater complexity, incomplete understanding and uncertainty. Governance will need to be adaptive and inclusive if it is to effectively support transitions to green growth, maintain social-ecological resilience and build adaptive capacities .

Redundancy is discussed in the context of the diversification and decentralization of energy supply systems, but this is certainly not the only area where diversification is important. To ensure greater resilience, domestic policies should encourage diversification of the economic base. Countries that have developed only a few key industries are particularly vulnerable to shocks, such as new protectionist policies by trading partners or increasing competition with other low-cost manufacturing hubs.

Agriculture is another area where diversification is important. While intensive agricultural systems will continue to be vital to ensure necessary increases in the productivity of staple crops, promoting more labour-intensive, small-scale practices based on ecologically viable, multicropping systems is also an important strategy for ensuring greater food access and utilization.

Finally, robustness is explored in the context of adaptation to climate change. Efforts to adapt to climate change must include ecosystem-based approaches, such as protecting mangrove ecosystems. Meanwhile, ongoing efforts must increasingly engage those most affected by climate change. Limited options for individuals and social groups lower their ability to adapt to climate change (and so lower their resilience). As a result, many measures are largely reactive and serve only to perpetuate current vulnerabilities.

While this chapter has not offered a comprehensive discussion of all aspects of resilience, it provided a number of specific examples of institutional, policy, and investment innovations that support resilience. A key lesson is that, in the face of surprising events of extreme stress, choices are possible. A sudden shock can lead to transformation—to something better, more resilient and more likely to lead to long-term prosperity. To accomplish this, decision makers must pay more attention to nurturing social and natural capital and fostering diversity in their economies, infrastructure, institutions and knowledge bases. Fortunately, in the last decade, large numbers of innovative policies, projects and other types of initiatives have been initiated in the Asian and Pacific region. Although there are no panaceas and generic development models remain elusive, much valuable experience has been gained that can be applied in the future.

CHAPTER 6: CONCLUSION

A changing policy and economic landscape

The rapid rise of the Asian and Pacific region is one of the most successful modern stories of economic development. With the developed world first experiencing a severe recession and then lackluster economic growth, the region is a source of strength in the global economy, accounting for growing levels of production, trade and investment. The region's economic transformation has also brought rising per capita income levels and falling poverty rates.

However, this rapid rise also poses significant challenges, which are impacting the region's economic, social and environmental outlook. The rise in population, the increase in wealth in developed countries, and the current rapid growth in developing countries have all contributed to rapidly expanding consumption of the earth's resources. As a result, the world may be entering an era in which meeting the demand for food, water, energy and other natural resources in an equitable way will pose serious challenges.

Countries with few resources and low resource efficiency may suffer most heavily from higher prices for resources. In these countries, converging economic, resource and environmental challenges will likely be the most pronounced. This will heavily impact the most vulnerable and impede progress towards achieving the Millennium Development Goals (MDGs). These concerns are growing against a backdrop of continued environmental degradation, mounting waste and pollution burdens, depletion of natural resources and climate change.

These challenges partly reflect economic growth strategies that have failed to account for the costs of environmental degradation and resource depletion and emphasized investments in modes of production that are resource intensive. This is of particular concern for the Asian and Pacific region given that: the region possesses the lowest per capita supply of many kinds of resources; many of the region's economies are net importers of resources, and thus are exposed to the risk of rising resource prices; and resource use efficiency in many developing countries of the region is significantly lower than that in developed countries. As of 2005, countries in the Asian and Pacific region required three times the input of resources as other countries to produce one unit of GDP, raising serious concerns about the sustainability of business-as-usual growth strategies.

The choices that Asian and Pacific countries make during the next few decades are critically important for the future of its people. A key dilemma will be how to meet the needs of expanding and increasingly affluent populations, while reducing poverty and staying within environmental limits.

Green growth: opportunities and benefits

In a changing development context, green growth – defined as economic progress that fosters environmentally sustainable, low-carbon and socially inclusive development – can be viewed as an economic opportunity and risk-management strategy. Pursuing green growth will allow economies and societies, particularly those in developing countries, to better face

an uncertain and resource-constrained future. Positive incremental changes towards green growth and a green economy are within reach and are indeed already happening throughout the region. Furthermore, the need for large new infrastructure investments in the region – including housing, transportation networks, energy and water supplies – offers planners and policy makers a unique opportunity to design these investments guided by the principles of sustainability, accessibility, eco-efficiency and social inclusiveness.

Green growth should not be viewed as an attempt to impose "ecological conditionalities" on developing countries. Indeed, those countries that are exploring policy innovations and becoming clean technology leaders are finding significant economic opportunities in making efficiency gains. Tapping the growing market for green goods and services, in particular emerging low-carbon and alternative energy technologies, can be a source of sustained economic growth, while also creating green jobs. Countries of the region are accounting for a growing share of this global market.

Policies and actions that promote environmentally sustainable economic growth can also lead to more resilient economies and societies. A shift to greener growth can help mitigate the impacts of adverse shocks by reducing the intensity of resource consumption and alleviating pressure on commodity prices. Robustness (the ability of a system to withstand a perturbation without significant loss of performance), redundancy (developing a diversity of pathways for achieving the same goal), and resourcefulness (the ability to diagnose, prioritize and initiate solutions to problems) are key principles in enhancing resilience to environmental, social and economic disturbances.

Finally, by promoting integrated approaches, green growth measures can help achieve multiple environmental, economic and social benefits while hastening a transition to a sustainable development pathway and a green economy. For example, investments in sustainable transport and urban planning help reduce greenhouse gas (GHG) emissions and local air and water pollution, while improving urban mobility, access to markets and public health. As the demand for ecosystem services grows, green growth measures also provide incentives for sustainable management of ecosystems on which regional economies and societies depend.

Making the transition, recalibrating economies

This report responds to a call that has emerged from delegates during the preparatory discussions for Rio +20 – the need for more concrete policy guidance. The report outlines an overarching set of principles for developing integrated policy frameworks that can be adapted to each country's needs and priorities. It also provides access to resource consumption data and physical trade balances that will help governments and other stakeholders better understand their resource risks.

A key message of this report is that incremental technological innovation and improvements in resource efficiency alone will not be sufficient to meet current and future challenges. Moving forward, policy decisions should be aimed at systemic changes that can dramatically improve resource efficiency and at the same time build inclusive and resilient economies.

To accomplish this, there is a need to recalibrate economies to better align economic growth patterns with the pursuit of sustainable development objectives. This will require reformed and effective economic incentives frameworks in which the gap between market prices and the economic value of ecosystem goods and services is narrowed, and in which the social costs of economic activity are internalized. The transition will also require specific and complementary financing mechanisms to help close the "time gap" – the delay between investing in green growth and realizing tangible economic benefits.

Governance frameworks at all levels, from international to local, must also adapt to a changing reality. Institutional arrangements that influence development must ensure much greater levels of policy integration, reducing policy conflicts and tradeoffs between the environmental, social and economic pillars of sustainable development. Adaptive and inclusive governance approaches can help identify effective solutions, improve policy and programme implementation, and mitigate risk and uncertainty in the policy environment. Effective institutional frameworks must fully engage society so that the benefits and any burdens are equitably shared and so that diverse perspectives can be brought to bear on multi-dimensional policy challenges. Local capacities

must also be built to adapt to change in ways that match localized needs.

In addition, the scale of the challenges requires increased investment and participation by the private sector, which has not yet invested in green sectors at the necessary scale. Collaborative action between governments and the private sector should focus on overcoming the barriers and risks that restrict capital flows into the sectors that support green growth. Governments play an important role in providing incentives through clear regulatory and institutional frameworks for increased finance and for various partnership arrangements. Domestic financial markets must also play an increasingly role in sustaining financial flows.

Finally, the scale of the challenges will require gradual but substantial changes in behavior and lifestyles. Political commitment, leadership and strengthened efforts to create awareness of the issues and solutions will be needed because the green economy will ultimately need to be built on reoriented values.

Green growth and poverty reduction

Although green growth strategies offer economic and social benefits, they cannot, on their own, ensure a more equitable society in which poverty is substantially reduced. While green growth can mitigate some of the resource constraints that impact the most vulnerable in society and favours livelihoods that have traditionally relied directly on natural resources, specifically targeted and designed programmes and policies will still be needed to strengthen and complement greening efforts.

As part of a green transformation, efforts should also be made to improve access to basic services for the rural and urban poor, including water supply, sanitation, and energy. For example, even as developing countries are expanding their use of clean, renewable energy, there are projections that by 2030, more, not fewer, people will be using biomass as source of fuel for cooking. This underlines the significance of designating 2012 as the International Year of Sustainable Energy for All.

An exploration of persistent poverty, inequality and its links to resource use is outside the remit of this report. Yet inequality and inefficient resource use are intimately linked and may have, at least partly, the same drivers. Countries that pursue capital-intensive economic growth will likely face a long-term challenge of creating jobs and maintaining low levels of unemployment. Economists, labour analysts and social scientists must work to better understand the linkages and identify solutions. At the same time, answers to critical questions, such as whether resources are being used in an equitable way to benefit people, require further investigation.

There must be recognition that there will be short-term costs in a green transition. Patterns of employment will change, and society must be ready to adjust. The capacity of developing countries to take advantage of new green jobs and develop the skills needed to succeed in a "green" market place must be built. Social protection programmes will also be needed to mitigate risks associated with unemployment.

Final thoughts

This report has been prepared nearly twenty years after the 1992 "Earth Summit," at a time when world leaders are preparing to reconvene to secure renewed political commitments to sustainable development. There is a growing global consensus on the urgent need for action. Numerous ideas and solutions will be explored. Meaningful, coordinated and strategically formulated action is now needed to change the prospects for achieving sustainable development.

Given the diversity of the region, there is no common blueprint that can be applied to all countries equally. Green growth strategies must be carefully adapted to national situations and investments prioritized depending on specific environmental, social and economic contexts.

Governments will require vision and political courage to take on long-term issues with benefits that will not be realized until well beyond the next election cycle. However, they also have a responsibility to ensure that conventional growth strategies and patterns of resource use are not promoted in the guise of green growth or a green economy. While there is little disagreement that a change is needed, there is still significant uncertainty that implementing green growth strategies will ensure a brighter outlook for all. Thus there needs to be a greater commitment

to putting people at the centre of development. International financial institutions, development banks and local financing institutions will also need to take important steps to change investment paradigms to support government actions.

Strengthened regional cooperation will also be essential. It is clear that developing countries need support and that any global discussion on green growth must not disadvantage developing countries. The potential for a global compact to support the most vulnerable must be explored. A package is needed of innovative financing and measures to establish partnerships between developed and developing countries to close development gaps, deal with interlinked challenges, such as the food, energy, water nexus, and secure greater investment in human capital, based on a more realistic economic approach.

ANNEX 1: RESOURCE FLOW ACCOUNTING

What is resource flow accounting? Rising population, industrial growth and emerging modern lifestyles in Asia and the Pacific are placing increasing strain on many natural resources at local, regional, and global levels. Using resources more efficiently will require an understanding of the flow of materials, energy and water from the time when they are extracted, processed, manufactured and used, to when they are finally discarded. It will also require information about the environmental, economic and social impacts of these flows. These considerations are becoming increasingly important to achieving green growth and resilience in Asia and the Pacific.

Resource flow accounts, by focusing on pressures on the environment, look more closely at the sources than at the symptoms of environmental problems. Data on material and energy flows and water allow policymakers and researchers to assess the flow of natural resources through an economy and to explore trends and relationships between economic growth patterns and natural resource use, as well as possible policy challenges and solutions. This is an important part of the response to growing resource constraints and a way to measure social progress and human well-being more comprehensively. This is necessary because standard measures of economic performance, such as gross domestic product (GDP), do not provide a complete assessment of social wealth and development.[1]

The measurement of material, energy and water flows is based on the concept that the socio-economic system is metabolizing resources to support its own physical growth and maintenance and gains in human well-being. This "industrial metabolism" approach to investigating the economy-environment interface[2] shares several important characteristics with the System of Economic and Environmental Accounting (SEEA).[3] However, while the SEEA assesses changes in the stock of environmental sources and sinks, resource flow accounting focuses on the throughput, or "flow" of materials and energy through an economy. Another important difference is that the resource flow accounting approach results in data that facilitates comparisons between countries, while comparability is difficult to achieve using SEEA approaches.

A decade of research and public policy engagement led by the European Statistical Office (EUROSTAT) and the Organisation for Economic Co-operation and Development (OECD) has informed the development of the methodology for establishing material flow accounts to ensure quality and international comparability, and provided guidance on how to interpret material flow accounts with regard to policies for sustainable resource use.4, [5]

Why is it important? Material, energy and water flow data are important to inform national security, industrial and public policy decisions. Many natural resources are strategic to the economic growth and security of nations and therefore require careful attention with regard to availability, dependence on foreign resources and use levels. Examples include fossil fuels and minerals, such as metallic ores or rare earth elements, that are strategic to certain production processes.

The importance of natural resource flow accounts in national security may be self-evident but other uses of this information are as vital and perhaps less obvious. Resource-flow accounts help in assessing alternative technologies with regard to resource availability and security of supply. In addition, greenhouse gas emissions and local

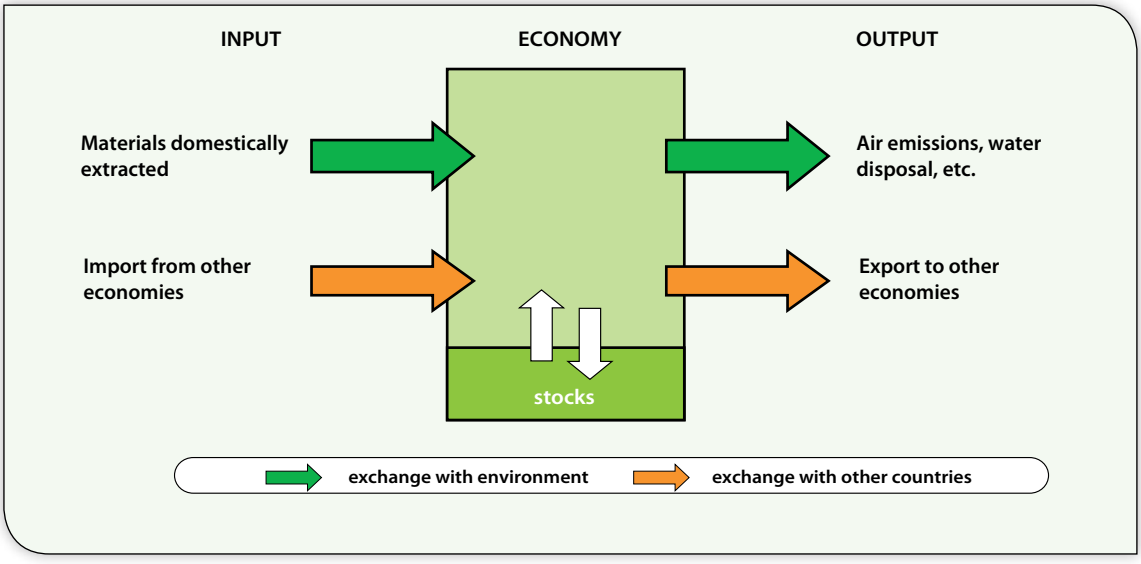
air pollution are intimately tied to resource-use patterns and overall resource demand.

Resource-flow accounts are relatively new; their value is not universally appreciated or even comprehensively demonstrated. Their utility has become increasingly recognized, however, in the context of sustainable resource use, climate change mitigation, circular economy and green growth policy domains, with leading examples in China, Europe and Japan.[6]

- The simple national resource flow accounts presented in this report offer a starting point for national initiatives to establish extended national resource flow accounts and physical input-output tables that could provide a range of benefits, including the following:
- National and state governments would gain better information on the sources and uses of renewable and non-renewable resources.
- Corporations would have better information on current and future supplies of materials they use and on the environmental and social impacts of these materials, to plan for new eco-efficient technologies and substitute materials in production processes.
- National integrated environment-economic strategies would be able to track sources, flows and disposal of materials to determine how to improve the effectiveness and efficiency of resource use by changing incentives to support socio-economic development and the environment.
- Waste and emission policies could rely on sound information on total amounts of material throughput and the waste and emission rates related to those throughputs.
- National security and trade departments could monitor the use levels and supply security of not only strategic materials, such as energy carriers and rare metals, but also more widely used materials.

How does it work? In resource flow accounting, natural resource flows are organized and quantified in order to track the amount of materials, energy and water (plus waste and emissions) that are used in any defined system over a certain period of time. The materials remaining in the system are also quantified to create a stock of capital. When organized in such a way, resource flow accounts are in many ways similar to financial accounts. Financial accounts report on revenues and expenses, cash flows, reserves and the competitive positions of national economies. Decision makers rely heavily on this information for planning and decision making. Similar to financial accounts, resource flow accounts report on inputs, outputs and accumulation of stocks and could, if implemented at regional and national scale, become critical to

Figure A1.1: Scope of basic material flow accounts



Source: Eurostat, *Economy Wide Material Flow Accounts: Compilation Guidelines for Reporting to the 2009 Eurostat Questionnaire* (Luxembourg, 2009), accessed from http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/Eurostat%20MFA%20compilation%20guide%20for%202009%20reporting.pdf on 3 February 2011.

planning and decision making in the context of sustainable development.

Figure A1.1 provides an overview of the accounting framework for simple material flow accounts, distinguishing inputs into and outputs from an economic system as well as material accumulation. For the basic accounts, the economy is treated as a "black box"; material transformation and goods domestically consumed become flows within the black box and are not reported.

Resource-use indicators examine specific aspects of the metabolism of an economy and correspond to "pressure" indicators in the logic of the [driver-pressure-state-impact-response] DPSIR framework.[7] Key indicators include total domestic extraction, physical trade balance and domestic material consumption per capita and per dollar of GDP.

- Domestic extraction (DE) provides information about all materials extracted on the territory of a national economy. It denotes the yearly decline of natural resource endowment for non-renewable resources and the pressure on ecosystems for producing renewable resources.
- Physical trade balance (PTB) provides information about physical imports and exports. The physical trade balance is defined in reverse to the monetary trade balance (that is, imports minus exports) taking account of the fact that in economies money and goods usually move in opposite directions. A physical trade surplus indicates a net import of materials, whereas a physical trade deficit indicates a net export.
- Domestic material consumption (DMC) summarizes the effects of domestic extraction (DE) and the physical net trade (PTB). DMC refers to all materials used for intermediate and final consumption in a country before being released to the environment as waste. DMC indicates the "domestic waste potential" of an economy, assuming that all materials eventually will turn into waste.[8]

Data are presented in tons and measure materials that enter the economic process, that is, materials that become commodities. Materials mobilized that do not enter the economic process (that is, unused extraction), such as overburden in mining or by-products in agriculture, are not included. A technical annex on the data sources used and methodologies employed is available from the database web site at www.csiro.au/AsiaPacificMaterialFlows.

Material flow indicators represent pressures on the environment and may be used as a proxy for environmental impact. However, different materials have different qualities and a specific impact profile may be assessed in a separate analytical step. There are several aspects of material flow methodology that are not covered by these basic accounts, including accounting for unused extraction, embodied flows, and material flows by economic activity. These aspects should be addressed in more comprehensive national data sets and studies.

How were material flow accounts developed for this report? The material flow accounts presented in this report are new. They were developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) along with partner institutes in China, India and Japan. They were prepared primarily for the United Nations Environment Programme (UNEP) report *Resource Efficiency: Economics And Outlook for Asia and the Pacific* (REEO).[9] Readers who wish to see more detailed analysis for certain natural resources or individual countries may consult the REEO report.

The accounts are based on a comprehensive data set for material flows and material intensity for 1970-2005 that covers most Asian and Pacific countries. The data, which are available online,[10] are presented for four main categories of materials (biomass, fossil fuels, metal ores and industrial minerals, and construction minerals) and 12 sub-categories (Table A1).

While waste and emissions are not covered in any detail, it is important to note that the use of materials and energy and the generation of waste and emissions are intimately linked. The two categories share many of the same drivers because natural resource use, waste and emissions are closely linked to current patterns of production and consumption. The international trade in natural resources and commodities (and the trade of waste) will require a regional approach to deal with shifting burdens across borders. Policy responses may reinforce one another in aiming to decouple resource use and waste generation from economic growth and human well-being.

Table A1.1: Main material categories of Asian and Pacific material flow accounts

Main material categories	Sub-categories	Items	Main use sectors
Biomass	Primary crops	Cereals, vegetables	Human nutrition and livestock
	Crop residues	Straw	
	Grazed biomass	Grass and hay	Energy and structural material
	Wood products	Timber	
Fossil energy carriers	Coal	Black and hard coal	Energy
	Petroleum	Crude oil	
	Natural gas	Methane	
Metal ores and industrial minerals	Iron ores	Copper, aluminium	Strategic materials for the construction and manufacturing sectors
	Non-ferrous metal ores		
	Industrial minerals		
Construction minerals	For concrete	Sand and gravel	Bulk materials for construction
	For other uses	Dimension stones, gravel	

Resource pricing, promoting resource efficiency and innovation, ensuring policy coherence and closing resource use and waste loops are some of the common characteristics of resource use and waste and emission policies.

How can the current data be improved? The resource flow accounts and key indicators are a first step in informing regional initiatives and national governments about the history, current conditions and most likely future of resource use, but far more needs to be done to prepare for the changing economics of resource use. Countries need to further develop institutional capacities, knowledge bases and data on natural resource use. Government departments, statistical offices and research institutes need to work together to address future challenges to resource supply security and to deal with the back end of resource flows, that is, waste and emissions.

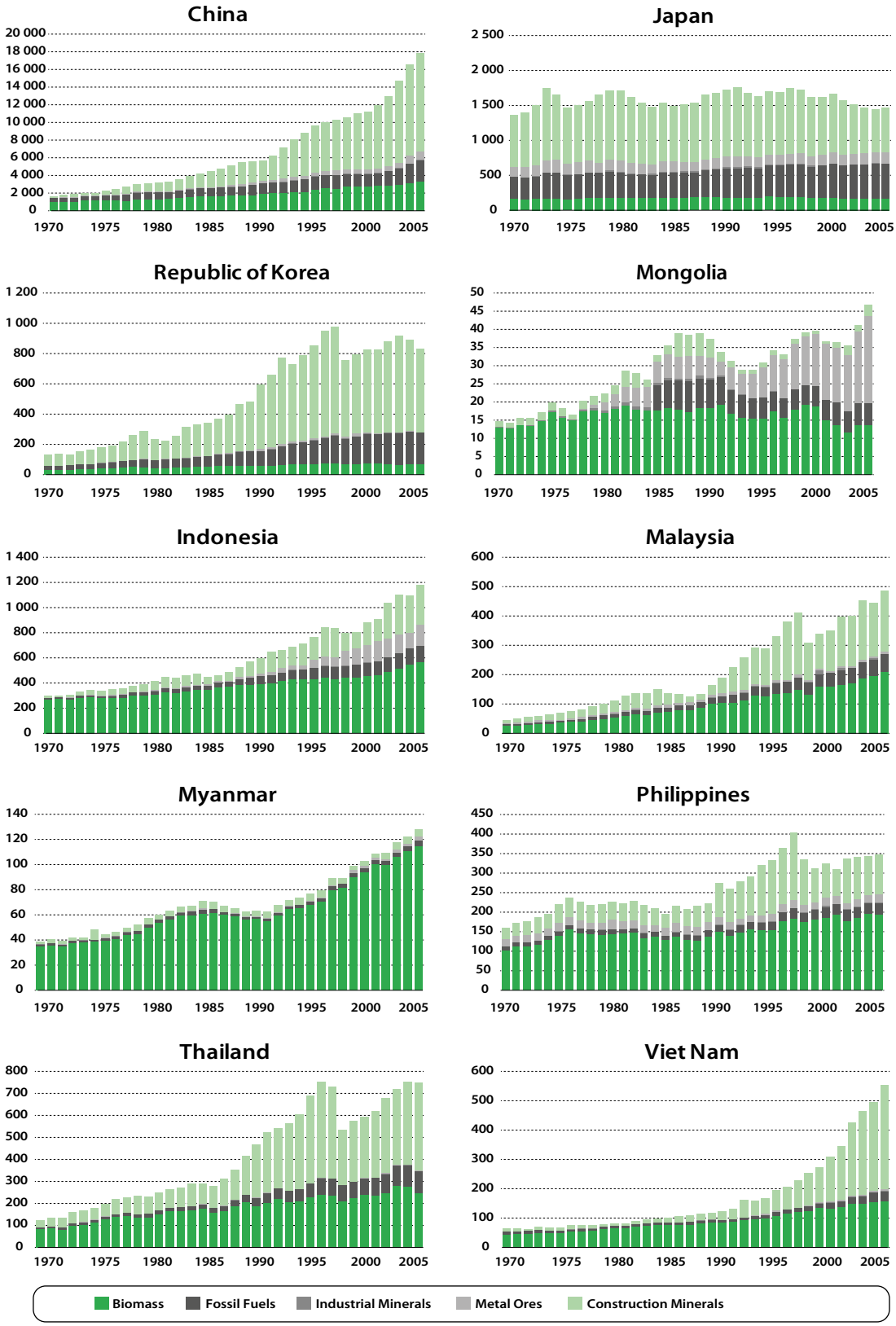
More specifically, the basic accounts presented need to be improved in the following ways:

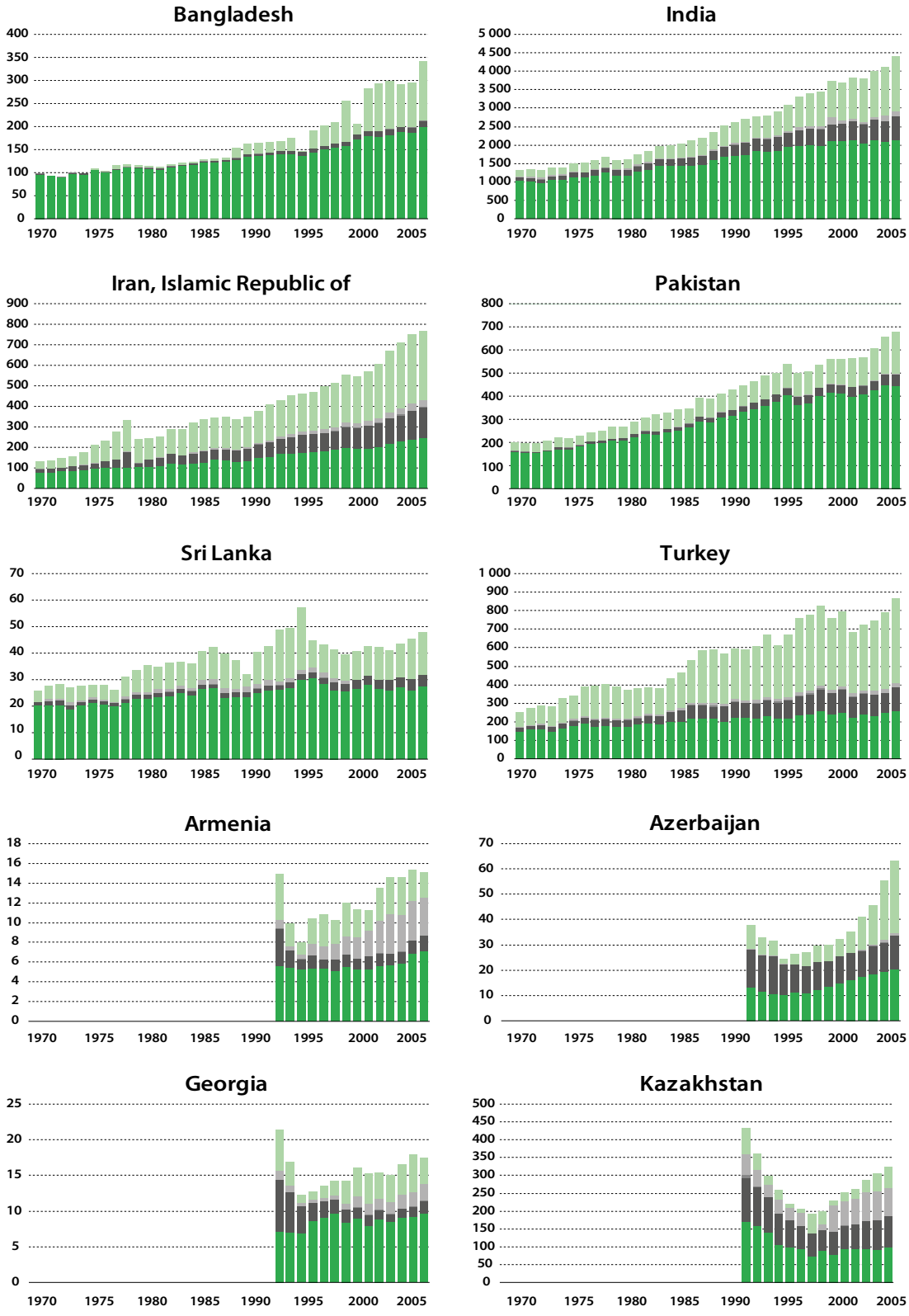
- National data sets need to be linked to resource use in specific economic sectors and activities to inform sectoral policies. This will require investment in physical input-output tables and economic sector accounts.
- Input flows and resource flows need to be better linked within a material balance approach. The dynamics between stocks and flows need to be appreciated to better plan for future maintenance costs and waste flows as well as to understand the potential for recycling.
- Direct accounts that measure resource flows related to production need to be complemented by accounts for indirect (embodied) flows to assess resource use from a consumption point of view.
- Resource flow and resource productivity information will require further tailoring to inform integrated environment and economic policies and programmes for pursuing a green growth and sustainability agenda.

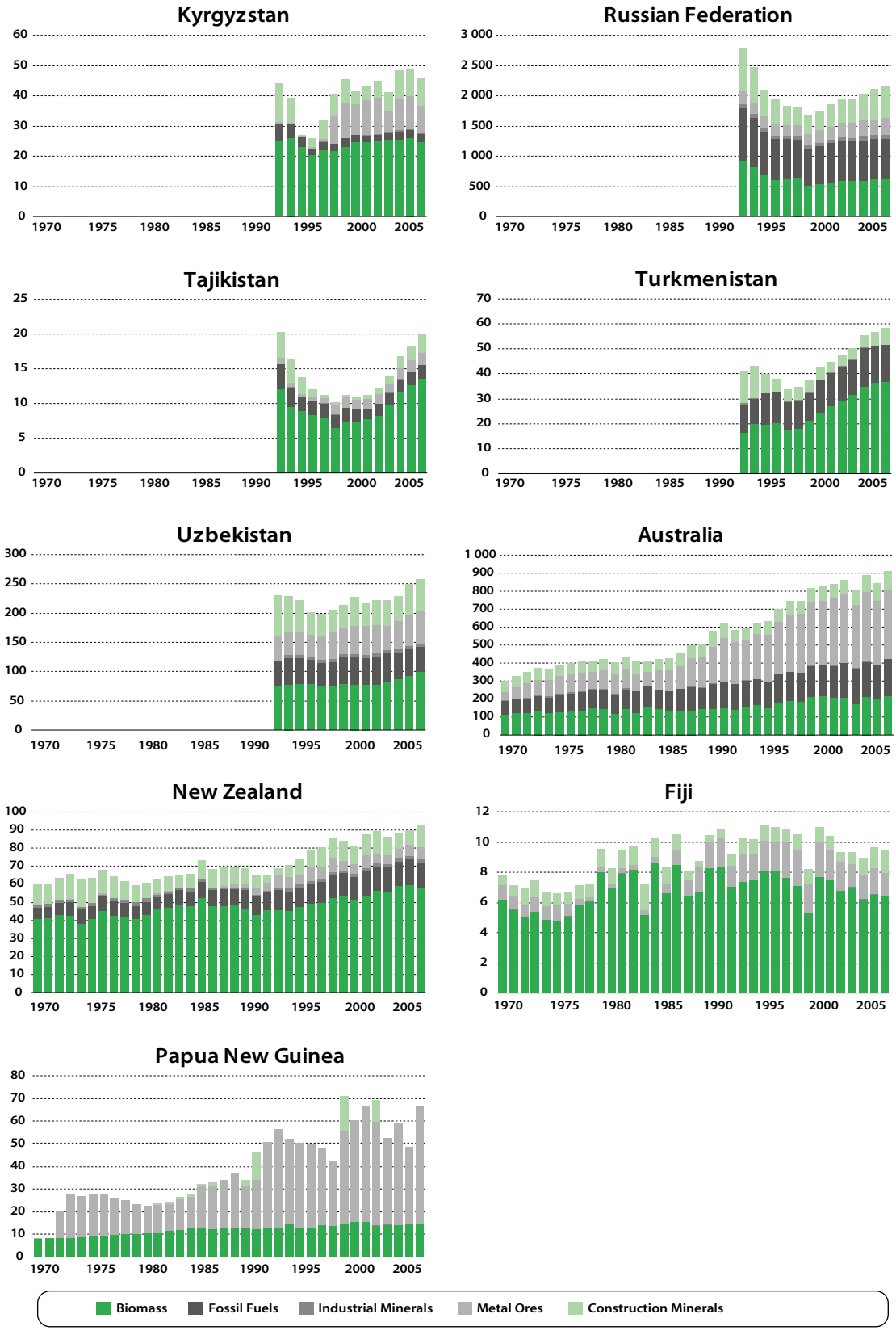
A well-developed knowledge base and information systems may eventually guide policy plans and programmes and may yield a triple dividend of enhanced competitiveness, greater wellbeing and sound environmental and resource use. It will be important to look both at the quantity and quality of resources used throughout the value chain. The objective should be inclusive socio-economic progress at a global level, rather than just shifting environmental burdens between regions.

ANNEX 2: MATERIAL CONSUMPTION FOR SELECTED ASIAN AND PACIFIC COUNTRIES

Figures A2.1-A2.30: Material consumption by main material categories for 29 Asian and Pacific countries, 1970-2005




Bangladesh
India
Iran, Islamic Republic of
Pakistan
Sri Lanka
Turkey
Armenia
Azerbaijan
Georgia
Kazakhstan
Biomass
Fossil Fuels
Industrial Minerals
Metal Ores
Construction Minerals



Source: CSIRO and UNEP Asia-Pacific Material Flow Database (www.csiro.au/AsiaPacificMaterialFlows)

ANNEX 3: DATA TABLES

Table A3.1: Per capita material use in Asian and Pacific countries, 1990, 1995, 2000 and 2005*

	Materials use (tons per capita)			
	1990	**1995**	**2000**	**2005**
Australia	35.86	37.63	43.36	44.20
Singapore	25.08	39.05	68.72	24.84
New Zealand	18.89	21.70	23.07	22.97
Kazakhstan	7.45	10.96	15.09	21.02
Malaysia	10.68	16.61	15.33	19.11
Korea, Republic of	14.62	20.20	18.74	18.86
Mongolia	17.82	13.58	16.57	18.41
Brunei Darussalam	21.35	12.88	16.94	16.17
Russian Federation	29.75	13.34	12.20	14.50
China	5.01	8.03	8.91	13.68
Turkey	10.53	11.01	11.97	12.22
Turkmenistan	5.34	9.06	9.93	12.09
Fiji	15.08	14.40	13.05	11.48
Thailand	8.51	11.63	9.34	11.34
Japan	13.97	13.33	12.91	11.22
Iran, Islamic Republic of	7.01	7.97	8.91	11.08
Papua New Guinea	11.65	10.54	13.73	10.98
Uzbekistan	2.28	8.91	8.78	9.89
Kyrgyzstan	2.36	5.70	8.75	8.82
Azerbaijan	3.38	3.23	4.10	7.70
Viet Nam	1.97	2.77	4.18	6.96
Korea, Democratic Republic of	14.46	12.44	5.12	5.71
Indonesia	3.33	4.05	4.24	5.37
Pakistan	3.97	4.41	4.05	4.41
Philippines	4.44	4.88	4.23	4.07
India	3.10	3.32	3.61	4.03
Lao People's Democratic Republic	2.09	1.94	2.46	3.89
Georgia	2.02	2.50	3.04	3.76
Tajikistan	0.91	2.09	1.83	3.07
Nepal	2.73	2.60	2.65	2.64
Sri Lanka	2.42	2.60	2.42	2.62
Myanmar	1.61	1.76	2.17	2.61
Bangladesh	1.45	1.55	2.06	2.31
Cambodia	1.68	1.74	2.32	1.82

Source: CSIRO and UNEP, Asia-Pacific Material Flow Database (www.csiro.au/AsiaPacificMaterialFlows)

*Presented in descending order of 2005 values.

Table A3.2: Material intensity in Asian and Pacific countries,1990, 1995, 2000 and 2005*

	Material Intensity (kilogrammes/$)			
	1990	**1995**	**2000**	**2005**
Mongolia	34.13	32.44	36.48	31.53
Kyrgyzstan	5.08	25.09	31.39	27.51
Papua New Guinea	20.41	13.94	20.98	17.50
Tajikistan	2.13	14.06	13.12	14.90
Uzbekistan	3.33	17.82	15.74	14.45
Viet Nam	8.68	9.08	10.41	12.92
Nepal	15.43	12.94	11.76	11.04
Kazakhstan	4.62	10.71	12.27	10.63
Lao People's Democratic Republic	9.21	7.23	7.65	9.72
China	12.79	12.21	9.39	9.42
Turkmenistan	5.13	15.94	15.39	9.31
Pakistan	8.54	8.56	7.56	7.28
India	9.72	8.93	7.97	6.84
Azerbaijan	2.70	6.63	6.27	6.51
Russian Federation	11.43	8.25	6.87	5.93
Bangladesh	5.67	5.44	6.15	5.76
Iran, Islamic Republic of	5.43	5.65	5.63	5.76
Indonesia	5.45	4.90	5.30	5.69
Fiji	8.17	7.29	6.19	4.99
Thailand	6.07	5.83	4.75	4.75
Cambodia	–	7.54	7.91	4.34
Malaysia	4.09	4.61	3.81	4.15
Georgia	1.35	5.46	4.70	3.86
Philippines	4.93	5.45	4.32	3.68
Turkey	3.16	3.07	2.98	2.61
Sri Lanka	4.22	3.68	2.77	2.59
Australia	2.09	2.08	2.05	1.91
New Zealand	1.70	1.79	1.75	1.55
Korea, Republic of	2.12	2.12	1.65	1.37
Singapore	1.71	2.02	2.99	0.92
Brunei Darussalam	1.14	0.68	0.94	0.91
Armenia	0.00	0.00	0.00	0.00

Source: CSIRO and UNEP, Asia-Pacific Material Flow Database (www.csiro.au/AsiaPacificMaterialFlows)
Material intensity is expressed as DMC per GDP (exchange values, 2000 prices)
*Presented in descending order of 2005 values.

Table A3.3: Per capita energy use in Asian and Pacific countries, 1990, 1995, 2000 and 2005*

	Energy use (gigajoules per capita)			
	1990	**1995**	**2000**	**2005**
Brunei Darussalam	293.40	338.38	316.77	383.12
Australia	215.11	218.92	241.66	254.86
Russian Federation	248.14	177.73	175.88	202.77
Korea, Republic of	91.19	136.83	168.71	195.49
Kazakhstan	188.62	138.30	118.72	189.43
New Zealand	167.11	180.31	196.36	166.06
Japan	150.45	167.14	173.79	162.56
Singapore	183.53	255.26	231.12	160.23
Turkmenistan	224.06	138.78	134.91	156.63
Iran, Islamic Republic of	52.97	67.24	77.79	117.56
Malaysia	53.93	80.32	92.21	112.84
Uzbekistan	94.65	78.23	85.57	77.41
China	31.84	36.42	36.67	66.84
Thailand	32.44	45.23	50.38	66.60
Azerbaijan	152.51	71.78	60.11	64.50
Turkey	39.52	42.28	48.43	55.79
Mongolia	68.01	50.17	41.61	50.10
Armenia	93.26	21.65	28.12	40.82
Indonesia	24.15	28.69	30.74	36.44
Korea, Democratic Republic of	69.05	42.39	36.10	35.55
Viet Nam	15.38	17.26	20.04	28.86
Georgia	94.39	31.01	25.57	28.68
India	15.77	17.40	18.95	22.81
Kyrgyzstan	71.70	22.33	20.79	22.69
Pakistan	16.84	18.58	19.39	20.89
Philippines	17.55	20.32	22.86	19.03
Sri Lanka	13.49	13.78	18.08	18.55
Tajikistan	44.00	23.70	19.30	15.25
Nepal	12.72	13.04	14.00	14.36
Myanmar	11.14	11.47	11.47	13.34
Bangladesh	4.64	5.23	5.57	7.31

Source: International Energy Agency.

*Presented in descending order of 2005 values.

Table A3.4: Energy intensity in Asian and Pacific countries,1990, 1995, 2000 and 2005*

	Energy intensity (megajoules/$)			
	1990	1995	2000	2005
Uzbekistan	–	156.49	153.29	92.20
Turkmenistan	–	244.30	209.10	91.84
Kazakhstan	–	135.20	96.59	79.67
Mongolia	130.28	119.81	91.60	67.90
Russian Federation	–	109.84	99.08	65.97
Tajikistan	–	159.34	138.42	62.25
Kyrgyzstan	–	98.31	74.62	60.44
Nepal	72.01	65.02	62.21	56.17
Iran, Islamic Republic of	41.00	47.72	49.11	52.77
Viet Nam	–	56.56	49.92	44.59
China	81.29	55.34	38.63	34.05
Indonesia	39.43	34.69	38.42	33.65
India	49.52	46.81	41.83	31.48
Pakistan	36.18	36.10	36.21	30.82
Azerbaijan	–	147.17	91.75	30.26
Armenia	–	46.88	45.25	26.86
Thailand	23.17	22.67	25.59	25.18
Georgia	–	67.77	39.48	22.92
Malaysia	20.68	22.29	22.88	21.89
Bangladesh	18.22	18.33	16.63	15.82
Philippines	19.48	22.71	23.39	15.53
Sri Lanka	23.51	19.50	20.71	15.47
Korea, Republic of	13.22	14.33	14.87	12.66
New Zealand	15.05	14.84	14.88	11.22
Turkey	11.85	11.81	12.04	10.65
Australia	12.55	12.08	11.43	10.45
Singapore	12.52	13.19	10.04	5.72
Japan	4.51	4.72	4.72	4.02

Source: International Energy Agency.
Energy intensity is expressed as TPES per unit of GDP (exchange values, 2000 prices)
*Presented in descending order of 2005 values.

Table A3.5: Per capita water use in Asian and Pacific countries, 1990, 1995 and 2000*

	Water use (cubic metres per capita)		
	1990	**1995**	**2000**
Turkmenistan	6 734	–	5 475
Uzbekistan	3 047	–	2 367
Kazakhstan	2 239	2,129	2 352
Kyrgyzstan	2 487	–	2 051
Tajikistan	2 263	–	1 938
Thailand	–	–	1 397
Iran, Islamic Republic of	–	1,408	1 384
Australia	–	–	1 249
Pakistan	–	–	1 227
Armenia	987	907	975
Viet Nam	821	–	920
Myanmar	–	–	724
Japan	–	–	697
Sri Lanka	571	–	674
India	589	–	636
Turkey	–	–	632
Bangladesh	–	–	564
Lao People's Democratic Republic	–	–	555
New Zealand	–	–	547
Russian Federation	557	–	524
China	440	–	499
Nepal	–	–	417
Indonesia	417	–	401
Korea, Republic of	–	–	396
Korea, Democratic Republic of	–	–	393
Malaysia	559	–	388
Philippines	–	396	367
Cambodia	–	–	319
Mongolia	–	–	183
Fiji	–	–	88
Papua New Guinea	–	–	13

Source: AQUASTAT, accessed from www.fao.org/nr/water/aquastat/main/index.stm on 11 July 2010
*Presented in descending order of 2005 values.

Table A3.6: Water intensity in Asian and Pacific countries,1990, 1995 and 2000*

	Water intensity (cubic metres/$)		
	1990	1995	2000
Tajikistan	5.31	–	13.90
Turkmenistan	6.46	–	8.49
Kyrgyzstan	5.35	–	7.36
Uzbekistan	4.45	–	4.24
Viet Nam	3.62	–	2.29
Kazakhstan	1.39	2.08	1.91
Nepal	–	–	1.85
Lao People's Democratic Republic	–	–	1.73
Bangladesh	–	–	1.69
India	1.85	–	1.40
Bangladesh	–	–	1.69
India	1.85	–	1.40
Cambodia	–	–	1.09
Sri Lanka	0.99	–	0.77
Thailand	–	–	0.71
China	1.12	–	0.53
Indonesia	0.68	–	0.50
Mongolia	–	–	0.40
Philippines	–	0.44	0.38
Russian Federation	0.21	–	0.30
Turkey	–	–	0.16
Malaysia	0.21	–	0.10
Australia	–	–	0.06
Fiji	–	–	0.04
New Zealand	–	–	0.04
Korea, Republic of	–	–	0.03
Japan	–	–	0.02
Papua New Guinea	–	–	0.02

Source: AQUASTAT, accessed from www.fao.org/nr/water/aquastat/main/index.stm on 11 July 2010.
Water intensity is expressed as water use per unit of GDP (exchange values, 2000 prices).
*Presented in descending order of 2005 values.

ANNEX 4: REVIEWERS AND OTHER CONTRIBUTORS

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ENDNOTES

About the report

1. United Nations Economic and Social Commission for Asia and the Pacific, Asian Development Bank and United Nations Environment Programme, *Preview: Green Growth, Resources and Resilience – Environmental Sustainability in Asia and the Pacific 2010* (United Nations Publication, ST/ESCAP/2582) (Bangkok, United Nations, 2010).
2. Preamble, Ministerial Declaration on Environment and Development in Asia and the Pacific, 2005, issued by the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific, Seoul, Republic of Korea, 2005.

Chapter 1

1. Economic and Social Commission for Asia and the Pacific, Asian Development Bank and United Nations Development Programme, "Achieving the Millennium Development Goals in an Era of Global Uncertainty", *Asia–Pacific Regional Report* 2009/10 (Bangkok, United Nations, 2010).
2. Economic and Social Commission for Asia and the Pacific, "Review of the state of the environment in Asia and the Pacific, 2005." in *Report to the 5th Ministerial Conference on Environment and Development, Preparatory Meeting of Senior Officials*, 24–26 March 2005, Seoul (E/ESCAP/SO/MCED(05)/1).
3. A ministerial forum to address the health effects of these environmental changes was established in South-East and East Asia in August 2007 with the support of the World Health Organization and the United Nations Environment Programme.
4. Economic and Social Commission for Asia and the Pacific, Asian Development Bank and United Nations Development Programme, *Paths to 2015: Priorities for MDG Achievement in Asia and the Pacific* (Bangkok, ESCAP, 2010), accessed from www.mdgasiapacific.org/files/MDG_RegionalReport20102011.pdf on 28 January 2011.
5. Economic and Social Commission for Asia and the Pacific, Asian Development Bank and United Nations Development Programme, Achieving the Millennium Development Goals in an Era of Global Uncertainty: *Asia–Pacific Regional Report* 2009/10 (Bangkok, United Nations, 2010).
6. Economic and Social Commission for Asia and the Pacific, *Economic and Social Survey of Asia and the Pacific, 2011* (ST/ESCAP/2586) (Bangkok, United Nations, 2011).
7. Asian Development Bank, *Poverty Reduction in ADB*, accessed from www.adb.org/poverty/ on 1 April 2011.
8. Economic and Social Commission for Asia and the Pacific, Asian Development Bank and United Nations Development Programme, *Paths to 2015: Priorities for MDG Achievement in Asia and the Pacific* (Bangkok, ESCAP, 2010), accessed from www.mdgasiapacific.org/files/MDG_RegionalReport20102011.pdf on 28 January 2011.
9. Economic and Social Commission for Asia and the Pacific, *Economic and Social Survey of Asia and the Pacific, 2011* (ST/ESCAP/2586) (Bangkok, United Nations, 2011).
10. Economic and Social Commission for Asia and the Pacific, *Economic and Social Survey of Asia and the Pacific, 2011* (ST/ESCAP/2586) (Bangkok, United Nations, 2011).
11. See "*'Jobless growth' in Asia fails to tackle poverty*", International Labour Organization press release, 20 February 2007, accessed from www.ilo.org/asia/info/public/pr/lang--en/wcms_bk_pr_171_en/index.htm on 28 February 2011. Countries covered by the report include China, India, Indonesia, Malaysia, the Philippines, Sri Lanka and Thailand.
12. J. Rockström, W. Steffen, K. Noone, A. Persson, F.S. Chapin III, E. Lambin,T. Lenton, M. Scheffer, C. Folke, H.J. Schellnhuber, B. Nykvist, C. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. Corell, V. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen and J. Foley, "Planetary boundaries: exploring the safe operating space for humanity", *Ecology and Society* (2009), vol. 14, No. 2, article 32.
13. J. Rockström and others, "Planetary boundaries: exploring the safe operating space for humanity", *Ecology and Society* (2009), vol. 14, No. 2, article 32.
14. World Economic Forum, *Global Risks 2011 Sixth Edition, an Initiative of the Risk Response Network*, accessed from http://riskreport.weforum.org/ on 2 February 2011.
15. E. Beinhocker, D. Farrel and A. Zainulbhai, "Tracking the growth of India's middle class", *The McKinsey Quarterly* (2007), vol. 3, pp. 50–61.
16. Estimated by Mastercard Worldwide, Asia-Pacific, cited in Y. Wong, "Understanding the affluent consumers of China", *Insights* (2007) Second Quarter, p.3.
17. H. Daly, "Economic in a full world", *Scientific American* (2005), vol. 293, Issue 3, accessed from http://sef.umd.edu/files/ScientificAmerican_Daly_05.pdf on 2 February 2011.
18. Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

19. Commission of the European Communities, "The raw material initiative—meeting our critical needs for growth and jobs in Europe", *Communication from the Commission to the European Parliament and the Council*, SEC (2008) 2741. Brussels, 4.1, COM(2008)699 final, accessed from www.euromines.org/who_is_downloads/raw_materials_initiative.pdf on 25 March 2010.

20. Note that these statistics are based on the Asian Development Bank grouping of regions. See *Energy Outlook for Asia and the Pacific* (Manila, Asian Development Bank, 2009).

21. In addition, coal imports have also increased sharply in two of the major energy consumers of the region, China and India.

22. Based on 2006 data for non-OECD Asia, Japan and Republic of Korea, from International Energy Agency, *Energy Statistics,* accessed from www.iea.org/Textbase/stats/index.asp on 15 July 2009.

23. International Energy Agency, *World Energy Outlook 2010, Executive Summary* (Paris, 2010), accessed from www.worldenergyoutlook.org/docs/weo2010/WEO2010_ES_English.pdf on 10 May 2011.

24. Peak oil is the point in time when world oil production reaches its highest rate, after which it goes into permanent decline, even in the face of rising economic demand.

25. United Nations Environment Programme, *Towards Sustainable Production and Use of Resources: Assessing Biofuels* (Nariboi, excerpt, undated), accessed from www.uneptie.org/energy/bioenergy/documents/pdf/Assessing%20Biofuels-Summary-Web-.pdf?bcsi_scan_9688B637A46568DB=0&bcsi_scan_filename=Assessing%20Biofuels-Summary-Web-.pdf

26. China and India plan to expand to approximately 120 and 30 gigawatts of installed capacity of nuclear power, respectively, in 2030, from the existing less than 10 gigawatts in each country. See Asian Development Bank, *Improving Energy Security and Reducing Carbon Intensity in Asia and the Pacific* (Manila, 2009).

27. A summary of ongoing research and development efforts can be accessed from www.world-nuclear.org/info/inf33.html

28. K. Halada, M. Shimada and K. Ijima, "Forecasting of the consumption of metals up to 2050", *Materials Transactions* (2009), vol. 50, pp. 453–460.

29. The demand for rare earth metals has expanded but faces supply constraints due to limited investments in extraction outside of constrained supply centres. Some minerals, such as lithium, which is widely used in the batteries needed for hybrid vehicles and renewable energy technologies, are available in only a few countries, where conflict is an issue.

30. P. Koven, "China imposes export quotas on rare earth elements", *Financial Post*, 12 July 2010, accessed from www.financialpost.com/news/ on 12 August 2010. See also X. Dingding, "Rare earth, common problem", 3 September 2009, *China Daily*, accessed from www.chinadaily.com.cn/business/2009-09/03/content_8649171. htm on 27 August 2010.

31. Stuart White and Dana Cordell, "Peak phosphorous: the sequel to peak oil", in *Sustainable Phosphorous Futures*, (Global Phosphorus Research Initiative, 2008), accessed from http://phosphorusfutures.net/peak-phosphorus on 13 May 2011.

32. Leadership Group on Water Security in Asia, *Asia's Next Challenge: Securing the Region's Water Future* (New York, Asia Society, 2009).

33. N. Ivanova, "Off the deep end — Beijing's water demand outpaces supply despite conservation, recycling, and imports", *Circle of Blue*, 3 May 2011, accessed from www.circleofblue.org/waternews/2011/world/off-the-deep-end-beijings-water-demand-outnumbers-supply-despite-conservation-recycling-and-imports/ on 18 May 2011.

34. K. Schneider, "In Era of climate change and water scarcity, meeting national energy demand confronts major impediments", *Circle of Blue*, 22 September 2010, accessed from www.circleofblue.org/waternews/2010/world/in-era-of-climate-change-and-water-scarcity-meeting-national-energy-demand-confronts-major-impediments/ on 3 February 2011.

35. Asian Development Bank and Asia-Pacific Water Forum, *Asian Water Development Outlook 2011* (Manila, ADB, 2011), preview accessed from www.adb.org/water/knowledge-center/brochures/awdo-a-preview.asp#2 on 7 June 2011

36. Leadership Group on Water Security in Asia, *Asia's Next Challenge: Securing the Region's Water Future* (New York, Asia Society, 2009).

37. United Nations Environment Programme and Asian Institute of Technology, *Freshwater Under Threat: South Asia* (Nairobi, UNEP, 2008).

38. Asian Development Bank, *Climate Change Adaptation in Himachal Pradesh; Sustainable Strategies for Water Resources* (Manila, 2010), accessed from www.adb.org/documents/books/cca-himachal-pradesh/cca-himachal-pradesh-3.pdf on 7 June 2011.

39. Asian Development Bank, *Climate Change Adaptation in Himachal Pradesh; Sustainable Strategies for Water Resources* (Manila, 2010), accessed from www.adb.org/documents/books/cca-himachal-pradesh/cca-himachal-pradesh-3.pdf on 7 June 2011.

40. In the Karakoram mountains some glaciers have over-ridden areas that have been ice-free for 50 years or more, as opposed to further north and east where glaciers are declining. In northern Karakoram in China, glaciers are receding and have resulted in increased number of glacial lake outburst floods. K. Hewitt, "The Karakoram Anomaly? Glacier expansion and the 'elevation effect', Karakoram Himalaya", *Mountain Research and Development* (2005) vol. 25, pp. 332–340; Y. Chen, C. Xu, Y. Chen, W. Li and J. Liu, "Response of glacial-lake outburst floods to climate change in the Yarkant River basin on northern

slope of Karakoram mountains, China", *Quaternary International* (2010), vol. 226, pp. 75–81.

41. Asian Development Bank, *Central Asia Atlas of Natural Resources* (Manila, 2010).

42. P. Gleick estimates the basic water requirement for human needs at 50 litres per person per day, based on "drinking water for survival, water for human hygiene, water for sanitation services, and modest household needs for preparing food." P. Gleick, "Basic water requirements for human activities: Meeting basic needs", *Water International* (1996), vol. 21, pp. 83–92, accessed from www.bvsde.paho.org/bvsacd/cd17/basic_wate. pdf on 18 September 2009. A recommended minimum requirement of 20 litres per day was adopted in 1977 by the World Health Organization and United Nations Children's Fund, but various other recommendations have been made, noting that minimum requirements differ depending on climate, physiology, demographics, infrastructure and technology among other factors.

43. Asian Development Bank and Asia-Pacific Water Forum, *Asian Water Development Outlook 2011* (Manila, ADB, 2011), preview accessed from www.adb.org/water/knowledge-center/brochures/awdo-a-preview.asp#2 on 7 June 2011.

44. Economic and Social Commission for Asia and the Pacific, *Financing an Inclusive and Green Future* (Bangkok, 2010).

45. Economic and Social Commission for Asia and the Pacific, *Enhancing Regional Cooperation in Infrastructure Development including that related to Disaster Management* (Bangkok, 2008).

46. Declaration of the World Summit on Food Security, World Summit on Food Security, Rome 16-19 November 2009, accessed from www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Final_Declaration/WSFS09_Declaration.pdf on 7 June 2010.

47. 2011 World hunger and poverty facts and statistics, accessed from www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm on 18 May 2011.

48. Asian Development Bank, *Global Food Price Inflation and Developing Asia* (Manila, 2011).

49. Other risks include bio-security risks from transboundary diseases, weeds and unintended genetic drift, for example from genetically-modified crops, as well as risks of disease and ecological instability from reduced biological diversity in agriculture.

50. E. Martin, "Food crisis threat, World Bank chief Zoellick", *China Daily* 18 April, accessed from www.chinadaily.com.cn/cndy/2011-04/18/content_12340944.htm on 3 May 2011.

51. United Nations, *The Millennium Development Goals Report, 2010* (New York, 2010).

52. Asian Development Bank, *Operational Plan for Sustainable Food Security in Asia and the Pacific* (Manila, 2009).

53. Asian Development Bank, *Global Food Price Inflation and Developing Asia* (Manila, 2011).

54. Economic and Social Commission for Asia and the Pacific, *Sustainable Agriculture and Food Security in Asia and the Pacific* (Bangkok, 2009).

55. Economic and Social Commission for Asia and the Pacific, *State of the Environment in Asia and the Pacific 2005* (Bangkok, 2005), based on FAO data.

56. J. von Braun and Meinzen-Dick, "'Land grabbing' by foreign investors in developing countries: risks and opportunities", *IFPRI Policy Brief*, 13 April 2009 (Washington, D.C., International Food Policy Research Institute, 2009).

57. UNEP and the International Panel for Sustainable Resource Management (2010). Towards Sustainable Production and Use of Resources: Assessing Biofuels, accessed on 3 June at http://www.unep.org/climatechange/mitigation/Portals/93/documents/Bioenergy/Flyer-x-Web.pdf

58. E. Martin, "'Food crisis threat': World Bank chief Zoellick", *China Daily* 18 April 2011, accessed from www.chinadaily.com.cn/cndy/2011-04/18/content_12340944.htm on 28 April 2011.

59. Asian Development Bank, *Positioning ADB's Disaster and Emergency Assistance Policy in a Changing Regional Environment* (Manila, 2008).

60. Under the most severe of Intergovernmental Panel on Climate Change (IPCC) global emissions scenarios, A1F1.

61. J. Gustavsson, *Global Food Losses and Food Waste: Extent, Causes, and Prevention* (Rome, FAO, 2011), accessed from www.fao.org/fileadmin/user_upload/ags/publications/GFL_web.pdf on 6 June 2011.

62. Based on a comparison of average calorific food intakes and undernourishment rates. FAO uses the Gini coefficient of dietary energy consumption as an indicator of inequality of access to food, with most recent data from 2000, and most data from the 1990s . See http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/AccessToFoodGini_en.xls.

63. Economic and Social Commission for Asia and the Pacific, *Sustainable Agriculture and Food Security in Asia and the Pacific* (Bangkok, 2009).

64. Economic and Social Commission for Asia and the Pacific, *Sustainable Agriculture and Food Security in Asia and the Pacific* (Bangkok, 2009).

65. S. Gillespie and L. Haddad, *Attacking the Double Burden of Malnutrition in Asia and the Pacific* (Manila, Asian Development Bank, 2001).

66. M. Ahmed, J. Maclean and M.A. Sombilla, Food security and climate change in the Pacific: rethinking the options, *Pacific Studies Series* (Manila, Asian Development Bank, 2011) Draft.

67. The present accepted definition of food security is that of the Declaration of the 2009 World Summit on Food Security: *Food security exists when all people, at all times, have physical, social and economic access*

to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

68. In February 2008, the Government of Indonesia announced that it would set aside 1.5 million hectares of land for food production in Papua to not only meet domestic food production needs, but also for export.

69. United Nations Environment Programme, *Global Environment Outlook 2000* (Nairobi, 1999), accessed from www.unep.org/Geo2000/english/0066.htm on 17 September 2010.

70. Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Synthesis*. (Washington, D.C., Island Press, 2005).

71. Data are for 2002-2003. Results of the GIST green accounting for Indian States project, cited in United Nations Environment Programme, *The Economics of Ecosystems and Biodiversity: an Interim Report* (Cambridge, European Communities, 2009).

72. Economic and Social Commission for Asia and the Pacific, S*tatistical Yearbook for Asia and the Pacific 2009* (Bangkok, United Nations, 2010).

73. Asian Development Bank, *Greater Mekong Subregion Overview* (Manila, 2010).

74. Asian Development Bank, *ADB Support to the Coral Triangle Initiative* (Manila, 2009).

75. Asian Development Bank, *Heart of Borneo Initiative*, accessed from www.adb.org/Environment/adb-hob.asp on 18 May 2011.

76. Asian Development Bank, *GMS Biodiversity Conservation Corridors Initiative: Strategic Framework and Technical assessment. Executive summary* (Manila, 2005).

77. Im-Erb, R., Y. Niino, S. Sombatpanit, R. Biancalani, Proceedings of the regional land degradation assessment in drylands (LADA) Workshop for Southeast Asia, *RAP publication* 2009/16 (Bangkok, FAO Regional Office for Asia and the Pacific, 2009).

78. Convention on Biological Diversity Secretariat, *Global Biodiversity Outlook 3*, p. 9 (Montreal, Convention on Biological Diversity Secretariat, 2010), accessed from http://gbo3.cbd.int/theoutlook/gbo3/executive-summary.aspx on 4 April 2010.

79. Association of Southeast Asian Nations, *ASEAN Biodiversity Outlook 2010* (Los Baños, ASEAN Center for Biodiversity, 2010), accessed from www.aseanbiodiversity.org. on 4 April 2010.

80. Based on data from the United Nations Population Division, *World Urbanization Prospects: The 2007 Revision* (New York, United Nations, 2007).

81. Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

82. Asian Development Bank, "Sustainable infrastructure", *In Focus Series* (Manila, 2009), accessed from www.adb.org/Media/InFocus/2009/sustainable-infrastructure.asp. on 12 January 2010.

83. Under a business-as-usual scenario, the total number of private vehicles in China and India combined could rise from about 19 million in 2005 to 273 million by 2035. Asian Development Bank, *Investing in Sustainable Infrastructure: Improving Lives in Asia and the Pacific* (Manila, 2009), accessed from www.adb.org/Documents/Reports/Sustainable-Infrastructure/sustainable-infrastructure.pdf on 10 January 2010.

84. United Nations Environment Programme, International Labour Organization, International Organisation of Employers, and International Trade Union Confederation, *Green jobs: Towards Decent Work in a Sustainable Low-Carbon World* (Washington, D.C., Worldwatch Institute, 2008).

85. For example, see Asian Development Bank, *Asian Environmental Outlook 2005 - Making Profits, Protecting our Planet: Corporate Responsibility for Environmental Performance in Asia and the Pacific* (Manila, Asian Development Bank, 2005); and Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, Asian Development Bank, 2008).

86. M. van Noordwijk and B. Leimona, "CES/COS/CIS paradigms for compensation and rewards to enhance environmental services", *Working Paper* No. 100, WP0129-10 (Bogor, World Agroforestry Centre [ICRAF], 2010).

87. This high-level forum of ministers of environment and of development of ESCAP member countries have met every five years since 1985,with ESCAP as the secretariat and ADB and UNEP as key partners.

88. These forums include the September 2009 International Conference on Green Industry in Asia, the January 2010 High-Level Asia-Pacific Dialogue on the Brussels Programme of Action for the Least Developed Countries, the February 2010 Pacific High-Level Dialogue on the Five-Year Review of the Mauritius Strategy for Further Implementation of the Barbados Programme of Action for Sustainable Development of Small Island Developing States (MSI+5) and the Pacific Conference on the Human Face of the Global Economic Crisis, the March 2010 Asia Productivity Organization International Conference on Green Productivity to Enhance Competitiveness.

89. Calls for a Green New Deal came from the Secretary General of the United Nations in late 2008. UNEP launched an initiative on a Global Green New Deal (accessed from www.unep.org/Documents.Multilingual/Default.asp?DocumentID=548&ArticleID=5955&l=en on 6 June 2010) calling on governments to allocate a significant share of stimulus funds to green sectors, such as energy-efficient buildings, sustainable transport, renewable energy and energy-efficient technologies, ecological agriculture and water conservation; the United Nations Division of Economic and Social Affairs' proposal for a Global Green New Deal for Sustainable Development was "part of a broader counter-cyclical response to the crisis", directed to support developing countries.

90. These forums include the September 2009 International Conference on Green Industry in Asia, the January 2010 High-Level Asia-Pacific Dialogue on the Brussels Programme of Action for the Least Developed Countries, the February 2010 Pacific High-Level Dialogue on the Five-Year Review of the Mauritius Strategy for Further Implementation of the Barbados Programme of Action for Sustainable Development of Small Island Developing States (MSI+5) and the Pacific Conference on the Human Face of the Global Economic Crisis, and the March 2010 Asia Productivity Organization International Conference on Green Productivity to Enhance Competitiveness.

91. United Nations General Assembly Resolution 64/236, "Implementation of Agenda 21, the Programme for the Further Implementation of Agenda 21 and the outcomes of the World Summit on Sustainable Development", accessed from www.unescap.org/esd/environment/rio20/pages/Download/ACONF216PC3E.pdf on 17 September 2010.

92. Nusa Dua Declaration, Bali, Para 13, Bali, Indonesia, February 2010, accessed from www.unep.org/gc/gcss-xi/Documents/Nusa_Dua_Declaration_Bali_Feb2010.pdf on 7 June 2010.

93. United Nations, *Official Records of the Economic and Social Council, 2006, Supplement No. 19. (E/2006/19 - E/ESCAP/1390),* Chapter IV, Resolution 66/1, para. 19 (a).

94. The Republic of Korea has adopted Low-Carbon Green Growth as a national vision. The Government of China has passed framework legislation to support greener growth, including the Circular Economy Law (effective in January 2009); the Renewable Energy Law that increases capital investment for new and renewable energy development in areas such as hydropower, solar, biogas and other low-carbon energy sources in rural areas (effective January 2006); and the amendment of the Energy Conservation Law (effective April 2008) to include price and fiscal reforms in support of energy resource conservation.

95. On December 2009, Japan announced to support developing countries to tackle climate change with approximately 1 trillion 750 billion Yen (about $15 billion) up to 2012. These are conditioned on a successful political accord, which is a fair and effective framework, supported by the participation of all major emitting countries and agreement of their ambitious targets.

96. UNEP Green Economy Initiative, based on data from N. Robins, R. Clover and C. Singh, A *Climate for Recovery: The Colour of Stimulus Goes Green* (London, HSBC Global Research, 2009).

Chapter 2

1. H. Weisz and H. Schandl, "Material use across world regions: inevitable pasts and possible futures", *Journal of Industrial Ecology* (2008), vol. 12, No. 5-6, pp. 629–636.

2. United Nations Environment Programme, *Resource Efficiency: Economics and Outlook for Asia and the Pacific* (Canberra, CSIRO Publishing, 2011).

3. The analysis, modeling and scenarios contained in the Resource Efficiency:Economics and Outlook (REEO) report for Asia and the Pacific are based on UNEP's geographical composition of countries for that region, which is different from that used in this report (which are based on ESCAP's geographical composition, as explained in the Notes). This explains any differences in the data on resource use and resource efficiency between the two reports, although the overall findings remain the same.

4. F. Krausmann, M. Fischer-Kowalski, H. Schandl and N. Eisenmenger, "The global socio-ecological transition: past and present metabolic profiles and their future trajectories", *Journal of Industrial Ecology* (2008), vol. 12, No. 5-6, pp. 637–656.

5. Domestic material consumption (DMC): summarizes the effects of domestic extraction (DE) and the physical net trade balance (PTB). DMC refers to all materials used for intermediate and final consumption in a country before being released to the environment as waste. DMC therefore indicates the 'domestic waste potential' of an economy, assuming that all materials eventually will turn into waste. H. Weisz, F. Krausmann, C. Amann, N. Eisenmenger, K. H. Erb, K. Hubacek and M. Fischer-Kowalski, "The physical economy of the European Union: Cross-country comparison and determinants of material consumption", *Ecological Economics* (2006), vol. 58, No. 4, pp. 676–698.

6. The use of energy is usually closely linked with material use and there is an overlap in material and energy flow indicators with respect to primary energy carriers (oil, gas and coal). Other forms of energy, such as water and nuclear power, are not represented well in material flow accounts. In that sense energy flow accounts are complementary to material flow accounts. They refine the overall picture but usually do not reverse it.

7. International Energy Agency. *Energy Balances for OECD and non-OECD Countries* (Paris, 2010).

8. S. Hashimoto and Y. Moriguchi, "Linkages among resources, climate, and Asian growth", *Journal of Industrial Ecology* (2010), vol. 14, No. 2, pp. 185–187.

9. J. G., Canadell, C. Le Quere, M. R. Raupach, C. B. Field, E. T. Buitenhuis, P. Ciais, T. J. Conway, N. P. Gillett, R. A. Houghton and G. Marland, "Contributions to accelerating atmospheric CO_2 growth from economic activity, carbon intensity, and efficiency of natural sinks", *Proceedings of the National Academy of Sciences of the United States of America* (2007), vol. 104, No. 47: 18866–18870.

10. Asian Development Bank, *Addressing Climate Change in Asia and the Pacific, 2010: Priorities for Action* (Manila, 2010).

11. N. Myers and J. Kent, *The New Consumers: The Influence of Affluence on the Environment* (Washington, D.C., Island Press, 2004).

12. S. Wirsenius, "Human use of land and organic materials: modelling the turnover of biomass in the global food system." Thesis, Department of Physical Resource Theory, Chalmers University of Technology, Goteborg, 2000.

13. Asian Development Bank, *Energy Outlook for Asia and the Pacific* (Manila, 2009).

14. G.Matos, Commodity flows. Unpublished spreadsheet compilations for series of major mineral commodities (United States Geological Service, Reston, Virginia, 2009).

15. Asian Development Bank, *Energy Outlook for Asia and the Pacific* (Manila, 2009).

16. Asian Development Bank, *Energy Outlook for Asia and the Pacific* (Manila, 2009).

17. In 2005, Papua New Guinea, the Lao People's Democratic Republic and Mongolia were all net exporters of natural resources while China, India and Thailand were net importers but still at very small per capita amounts.

18. This phenomenon of increasing natural resource exploitation and declining manufacturing sector has been named Dutch disease after the example of the Dutch manufacturing decline following the discovery and exploitation of large natural gas fields in the late 1950s.

19. F. Krausmann, S. Gingrich, N. Eisenmenger, K. H. Erb, H. Haberl and M. Fischer-Kowalski, "Growth in materials use, GDP and population during the 20th century", *Ecological Economics* (2009), vol. 68, No. 10, pp. 2696–2705.

20. E. G. Hertwich and G. P. Peters, "Carbon footprint of nations: a global, trade-linked analysis", *Environmental Science and Technology* (2009), vol. 43, No. 16, pp. 6414–6420.

21. The UNDP identifies 'oil intensity' as an indicator of dependence on oil, and therefore of vulnerability to rising oil prices. Larger countries, such as China, India and Thailand, seem more vulnerable because of higher oil intensities and dependencies, but at the same time, smaller countries that use oil for critical purposes, such as power generation and transport, are also at risk. United Nations Development Programme. *Overcoming Vulnerability to Rising Oil Prices: Options for Asia and the Pacific* (Bangkok, UNDP Regional Centre, 2007).

22. United Nations Environment Programme, *Resource Efficiency: Economics and Outlook for Asia and the Pacific* (Canberra, CSIRO Publishing, 2011). This report covers the Asia-Pacific region, as defined by UNEP.

23. This scenario embodied a 25% increase in efficiency in both material and energy use by 2050 and a moderate 1% per annum increase in labour productivity. Historical trends in types of technologies used were continued and consumption and economic activity were assumed to increase to achieve employment targets and a trade balance.

24. H. Daly, "Economic in a full world", Scientific American (2005), vol. 293, Issue 3, accessed from http://sef.umd.edu/files/ScientificAmerican_Daly_05.pdf on 2 February 2011.

25. P. Victor, "Ecological economics and economic growth", *Annals of the New York Academy of Science* (2010), vol. 1185, pp. 237–245. The author notes that "economic growth measured as an increase in real gross domestic product (GDP) has generally been associated with increases in the use of energy and materials and the generation of wastes." Scale, composition, and technology are the proximate determinants of environmental impacts. They are often reduced to two: scale (GDP) and intensity (impact per unit GDP) New work described in this paper defines "green" growth as intensity that declines faster than scale increases. Similarly, "brown" growth occurs when intensity declines more slowly than increases in scale, and "black" growth happens when both scale and intensity increase."

26. D.H. Meadows and others, *The Limits to Growth* (Washington, D.C., Potomac Associates, 1972).

27. J. B. Schor, *The Overspent American: Upscaling, Downshifting and the New Consumer* (New York, Basic Books, 1998).

Chapter 3

1. G. Chichilnisky and K. Sheeran, *Saving Kyoto* (London, New Holland Publishers, 2009); G. Chichilnisky, "The greening of the Bretton Woods", *Financial times*, 10 January 1996, p. 8; G. Chichilnisky, "Global payments for ecosystem services: principles and practice", in T. Koellner, ed., *Ecosystem Services and Global Trade of Natural Resources* (Abingdon, Routledge, 2010); G. Chichilnisky, *Managing the Global Commons: Principles and Practice* (Copenhagen, European Environmental Agency, 2010).

2. United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, a Synthesis for Policy Makers* (Nairobi, 2011), accessed from www.unep.org/greeneconomy on 4 March 2011.

3. The 'new policies' scenario quantifies the impacts of the broad-based policy commitments made by governments regarding greenhouse gas emission targets and reducing fossil fuel subsidies. It projects significant reductions in greenhouse gas emissions and energy demand, as well as increased share of renewable energy compared with the 'current policies' or 'reference' scenarios.

4. International Energy Agency, *World Energy Outlook 2007: China and India Insights* (Paris, 2007), accessed from www.iea.org/textbase/nppdf/free/2007/weo_2007.pdf?bcsi_scan_9688B637A46568DB=0&bcsi_scan_filename=weo_2007.pdf on 9 May 2011.

5. For example, see Asian Development Bank, *Asian Environmental Outlook 2005 - Making Profits, Protecting Our Planet: Corporate Responsibility for Environmental*

Performance in Asia and the Pacific (Manila, Asian Development Bank, 2005); and Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

6. Donald Aitken, *Germany Launches its Transition to All Renewables* (Sustainable Business.com, 2005), accessed from www.sustainablebusiness.com/index.cfm/go/news.printerfriendlyfeature/id/1208 on 5 March 2010.

7. A.A. Yusuf, *The Distributional Impact of Environmental Policy: The Case of Carbon Tax and Energy Pricing Reform in Indonesia*, (Singapore, Economy and Environment Program for Southeast Asia, 2008).

8. Data from the National Economic Survey (SUSENAS), Cited in M. Basri and G. Papanek, "Social protection policy in Indonesia", in S. W. Handayani and B. Babajanian, eds., *Proceedings of the workshop on social assistance* (Manila, Asian Development Bank, forthcoming).

9. A. Markandya, "The cost of environmental regulation in Asia: command and control versus market-based instruments", *Asian Development Review* (1998) vol. 16, No. 1, pp. 1–30.

10. Members of the Group of Twenty (G-20) Finance Ministers and Central Bank Governors: Argentina, Australia, Brazil, Canada, China, European Union, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russian Federation, Saudi Arabia, South Africa, Turkey, United Kingdom and United States of America.

11. D. Coady, M. El-Said, R. Gillingham and others, "The magnitude and distribution of fuel subsidies", *International Monetary Fund Working Paper Series* (Washington, D.C., International Monetary Fund, 2006).

12. Economic and Social Commission for Asia and the Pacific, *2010 Statistical Yearbook for Asia and the Pacific* (Bangkok, United Nations, 2011).

13. Global Canopy, *Little Biodiversity Finance Book*, accessed from http://www.globalcanopy.org/materials/little-biodiversity-finance-book om 10 Januaru 2011.

14. L. Gamez, comments at the Policymakers Forum: Economic Policy and Financial Innovation for Investment in Forest Environmental Services, 28-29 May 2007, Bangkok, Thailand.

15. L. Gamez, comments at the Policymakers Forum: Economic Policy and Financial Innovation for Investment in Forest Environmental Services, 28-29 May 2007, Bangkok, Thailand.

16. Arnoud van der Slot, Ward van den Berg and Gijs Berkhout, *Clean Economy, Living Planet: the Race to the Top of the Cleantech Market* (Amsterdam, Ronald Berger Strategy Consultants), accessed from http://assets.wnf.nl/downloads/clean_economy__juli2011_lr.pdf on 3 July 2010.

17. For example, see Emma Boyde, " Nikko AM World Bank green bond funds raise $650m," *Financial Times*, 17 March 2011, accessed from www.ft.com/cms/s/0/432836bc-4fe3-11e0-a37e-00144feab49a.html#axzz1MRRGJEGW on 14 May 2011.

18. Asian Development Bank, "Sustainable infrastructure", *In Focus Series* (Manila, 2009), accessed from www.adb.org/Media/InFocus/2009/sustainable-infrastructure.asp. on 12 January 2010

19. For example, see Asian Development Bank, *Asian Environmental Outlook 2005 - Making Profits, Protecting our Planet: Corporate Responsibility for Environmental Performance in Asia and the Pacific* (Manila, Asian Development Bank, 2005); and Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

20. Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

21. The $8 trillion estimate is from the Asian Development Bank and the Asian Development Bank Institute (ADBI), *Infrastructure for a Seamless Asia* (Tokyo, ADBI, 2009).

22. Warren Karlenzig and Daniel Zhu, "China's provincial and city low carbon pilot programs: a new opportunity for global emissions reductions" in *"Low Carbon Accounting, Management and Credit System",* accessed from http://www.commoncurrent.com/pubs/Shanghai.WK.11.7.10.pdf on 6 February, 2011.

23. Ministry of Urban Employment and Poverty Alleviation and Ministry of Urban Development, Government of India, *Jawaharlal Nehru National Urban Renewal Mission overview*, accessed from http://jnnurm.nic.in/wp-content/uploads/2011/01/PMSpeechOverviewE.pdf on 6 February 2011.

24. Clean Air Initiative, *ASEAN Working Group on Environmentally Sustainable Cities*, accessed from http://cleanairinitiative.org/portal/node/119 on 8 February 2011.

25. Housing and Development Board, Government of Singapore, *HDB to Develop Punggol as Singapore's First Eco-Town for the Tropics* (Singapore, January 2010), accessed from www.hdb.gov.sg/fi10/fi10296p.nsf/PressReleases/38ED16EFE18DDA8C482576B800265A27?OpenDocument on 10 February 2011.

26. Global Environment Centre Foundation, *Eco-Towns in Japan-Implications and Lessons for Developing Countries and cities* (Osaka, 2005), accessed from www.unep.or.jp/ietc/Publications/spc/Eco_Towns_in_Japan.pdf on 10 February 2011.

27. United Nations Department of Economic and Social Affairs (DESA), "A global green new deal for sustainable development", *Policy Brief* No. 12, accessed from www.un.org/esa/policy/policybriefs/policybrief12.pdf on 29 August 2010; DESA, *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (New York, United Nations, 2009).

28. Asian Development Bank and Asia-Pacific Water Forum, *Asian Water Development Outlook 2011* (Manila, Asian Development Bank, 2011), preview, accessed from www.adb.org/water/knowledge-center/brochures/awdo-a-preview.asp#2 on 5 March 2011.

29. United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, a Synthesis for Policy Makers* (Nairobi, 2011), accessed from www.unep.org/greeneconomy on 4 March 2011.

30. Economic and Social Commission for Asia and the Pacific, *State of the Environment in Asia and the Pacific 2005: Economic Growth and Sustainability* (Bangkok, United Nations, 2006).

31. Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

32. For example, biomass–biogas systems are being deployed in rural and agricultural households in Viet Nam with support from the Asian Development Bank (ADB) Energy for All Program. Decentralized treatment plants are being deployed in large buildings in China; see ADB, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

33. Adriaan Mels and others, "Decentralized wastewater reclamation systems in Beijing – adoption and performance under field condition", paper presented at First SWITCH Scientific Meeting, University of Birmingham, 9-10 January 2006.

34. ADB has estimated that $38 billion per year of investments in water and sanitation are required from 2010 through 2020 for business as usual. Asian Development Bank (ADB) and Asian Development Bank Institute (ADBI). *Infrastructure for a Seamless Asia* (Tokyo, ADBI, 2009).Detailed discussion of sanitation issues can be found in: Asian Development Bank, *Asian Sanitation Databook 2008: Achieving Sanitation for All* (Manila, 2009), accessed from www.adb.org/Documents/Books/sanitation-dbook/2008/default.asp on 12 January 2010. A synopsis of broader infrastructure issues can be found in: Asian Development Bank, "Sustainable infrastructure", *In Focus Series* (Manila, 2009), accessed from www.adb.org/Media/InFocus/2009/sustainable-infrastructure.asp. on 12 January 2010.

35. Waterless urinals have been deployed in several countries in the region, and can achieve typical water savings of 8 per cent in a building that is fully fitted or retrofitted. Aside from the water savings, the energy required to pump water is reduced, plumbing maintenance is reduced, and restrooms remain cleaner. See Asian Development Bank, *Towards Resource Efficient Economies in Asia and the Pacific* (Manila, 2008).

36. A sustainable transport system minimizes the use of land and emissions, waste and noise. It uses renewable resources at or below their rates of generation, uses non-renewable resources at or below the rates of development of renewable substitutes, and limits emissions and waste within the planet's ability to absorb them. In terms of cost, a sustainable transport system is one that is affordable and operates efficiently, taking into account requirements for investment in capacity and the need for maintenance. Sustainable transport also supports a competitive economy and balanced regional development, as well as promotes equity. In the longer term, urban transport provision and urban development need to be closely coordinated to create more liveable cities with shorter journey times and distances.

37. For a discussion on the Guangzhou BRT system, see L. Nadal, K. Fjellstrom and M. Hu, "Fast and green: China's push for bus rapid transit and green urban areas," presentation at China Environment Forum, The Woodrow Wilson International Center for Scholars, Washington, D.C., 30 June 2010, accessed from www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.event_summary&event_id=622607 on 3 July 2010.

38. For a summary on the Ahmedabad BRT, see Christopher Kost, "Janmarg, the people's way", *Sustainable transport* (Winter 2009), No. 21 (New York, Institute for Transportation Development and Policy, 2009).

39. Christian Zurbrügg, "Urban solid waste management in low-income countries of Asia: how to cope with the garbage crisis", paper presented at the Scientific Committee on Problems of the Environment (SCOPE) Urban Solid Waste Management Review Session. Durban, November 2002.

40. Preliminary results presented by Haripriya Gunimeda of the TEEB at the ASEAN Conference on Biodiversity,

41. Singapore, 21-23 October 2009.

42. Economic and Social Commission for Asia and the Pacific, "Investment in the sustainable management of natural resources: emerging opportunities and policies", Note by the secretariat. E/ESCAP/MCED(6)/8, 30 July 2010

43. Grace B. Villamor, Meine van Noordwijk, Flordeliz Agra and Delia Catacutan, "Buyers' perspectives on environmental services (ES) and commoditization as an approach to liberate ES markets in the Philippines", *ICRAF Working Paper* (2007) No. 51.

44. World Resources Institute, *Corporate Ecosystem Services Review*, (Washington, D.C., 2009), accessed http://www.wri.org/publication/corporate/ecosystem-services-review On 10 January 2011.

45. James Peters, "Ecosystem services in ASEAN and the GMS: biodiversity conservation and challenges and responses in moving from theory to implementation", presented at the ASEAN Conference on Biodiversity, Singapore, 20 August 2009.

46. See Sven Wunder, "Payments for environmental services: some nuts and bolts", *Occasional Paper* No. 42, (Bogor, Center for International Forestry Research [ICRAF], 2005).

47. "Innovative socio-economic policy for improving environmental performance: Payments for ecosystem services", *Greening of economic growth series* (United Nations Publication, ST/ESCAP/2560, 2009).

48. Rewards for, use of and shared investment in pro-poor environmental services (RUPES) programme of the World Agroforestry Centre, accessed from http://rupes.worldagroforestry.org on 3 January 2011.

49. In Costa Rica, by contrast, individual and business contributions to the fund that provides payments for commitments to forest management are received from various sectors, facilitated by flexible payment modalities and corporate incentives, including tax and certificates.

50. L. Gamez, comments at the Policymakers Forum: Economic Policy and Financial Innovation for Investment in Forest Environmental Services, 28-29 May 2007, Bangkok, Thailand.

51. G. Chichilnisky and K. Sheeran, *Saving Kyoto* (London, New Holland Publishers, 2009); G. Chichilnisky, "The greening of the Bretton Woods", *Financial times*, 10 January 1996, p. 8; G. Chichilnisky, "Global payments for ecosystem services: principles and practice", in T. Koellner, ed., *Ecosystem Services and Global Trade of Natural Resources* (Abingdon, Routledge, 2010); G. Chichilnisky, *Managing the Global Commons: Principles and Practice* (Copenhagen, European Environmental Agency, 2010).

52. Economic and Social Commission for Asia and the Pacific, *Sustainable Agriculture and Food Security in Asia and the Pacific*. (United nations, Bangkok, 2009, accessed from www.unescap.org/65/documents/Theme-Study/st-escap-2535.pdf on 3 July 2010.

53. United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, a Synthesis for Policy Makers* (Nairobi, 2011), accessed from www.unep.org/greeneconomy on 4 March 2011.

54. In addition to the threats to food supply posed by price increases and limited supplies of agricultural inputs, as well as climate change, there are other risks: biosecurity risks from transboundary diseases, weeds, and unintended genetic drift, for example from genetically-modified crops and risks of disease and ecological instability from reduced biological diversity in agriculture.

55. Food and Agriculture Organization of the United Nations (FAO), *Food Outlook: Global Market Analysis*, *November 2010* (Rome, 2010), accessed from www.fao.org/docrep/013/al969e/al969e00.pdf on 24 November 2010.

56. Jane Dixon, '*Health" a Missing Dimension.' Securing Food Futures in the Asia Pacific: Evaluating Regional Frameworks for Food Security,* National Centre for Epidemiology and Population health (Australian National University, 2010), accessed from /www.rsis.edu.sg/nts/Events/Conference%20Presentations/Food%20Security/Health-Jane%20Dixon.pdf on 21 June 2011.

57. A. Dobermann and D. Dawe, "Can organic agriculture feed Asia?" *Rice Today* (2008) vol. 7, No. 4, p. 42.

58. J. Ali and A.F. Santiaguel, "Greener rice" *Rice Today* (2010) vol. 10, No. 1, pp. 27–29.

59. Asian Development Bank, *Global Food Price Inflation and Developing Asia* (Manila, 2011).

60. United Nations Conference on Trade and Development and United Nations Environment Programme, *Organic Agriculture and Food Security in Africa* (New York, United Nations, 2008), accessed from www.unctad.org/en/docs/ditcted200715_en.pdf on 18 May 2011.

61. N. El-Hage Scialabba, "Organic agriculture and food security", paper presented at the International Conference on Organic Agriculture and Food Security, Rome, May 2007 (Rome, Food and Agriculture Organization of the United Nations [FAO]).

62. International Labour Organization (ILO) and Asian Development Bank (ADB), *Women and Labour Markets in Asia: Rebalancing for Gender Equality* (Bangkok: ILO Regional Office for Asia and the Pacific; and Manila, ADB, 2011).

63. United Nations Environment Programme, *Green jobs: Towards Decent Work in a Sustainable, Low-Carbon World* (Nairobi, 2008), accessed from www.unep.org/labour_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Towards-Sustainable-Summary.pdf on 15 February 2011.

64. Ministry of Environment, Republic of Korea, *The Presidential Committee on Green Growth*, accessed from http://eng.me.go.kr/content.do?method=movecontent&menucode=pol_pol_edu_gov_growth on 16 February 2011.

65. International Labour Organization Regional Office for Asia and the Pacific, *Green Jobs in Asia and the Pacific: Facts and Figures,* accessed from http://greenjobs-ap.ilobkk.or.th/green-jobs-in-asia-and-the-pacific-facts-and-figures/ on 18 May 2011.

66. International Labour Organization (ILO) and Asian Development Bank (ADB), *Women and labour markets in Asia: rebalancing for gender equality* (Bangkok: ILO Regional Office for Asia and the Pacific; and Manila, ADB, 2011).

Chapter 4

1. O.R. Young, "The effectiveness of international institutions: hard cases and critical variables", in J.N. Rosenau and E.-O. Czempiel, eds., *Governance without Government: Order and Change in World Politics* (Cambridge, Cambridge University Press, 1992), pp. 160–194.

2. David Daokui Li, and Suzanne Nora Johnson, "Everybody's business: strengthening international cooperation in a more interdependent world", in *Report of the Global Redesign Initiative* (World Economic Forum, 2011), accessed from https://members.weforum.org/pdf/grs2010/report/3-Intl-Monetary-and-Financial-System.pdf on 12 May 2011.

3. United Nations General Assembly, "Synthesis report on best practices and lessons learned on the objectives and themes of the conference: note by the Secretariat", paper presented at the First Intersessional Meeting for the United Nations Conference on Sustainable Development, 10-11 January 2011 (A/CONF.216/PC/3, New York, 2011).

4. United Nations General Assembly, *Objectives and Themes of the United Nations Conference on Sustainable Development*, *Report of the Secretary General* (A/CONF.216/7, New York, 2011), accessed from www.uncsd2012.org/index.php?option=com_content&view=article&id=154:secretary-generals-report-on-objectives-and-themes&catid=72:preparatory-committees&Itemid=123

5. United Nations Environment Programme, *Global Environment Outlook 4: Environment for Development* (Nairobi, 2007).

6. United Nations Environment Programme, "Importance of environmental pillar to IFSD", in The environmental dimension of the institutional framework of sustainable development (IFSD), *Issue Brief* No. 1 (Nairobi, 2011), accessed from www.unep.org/environmentalgovernance/IssuesBriefsontheInstitutionalFramework/tabid/54126/Default.aspx on 14 June 2011.

7. United Nations Environment Programme, "Fragmentation of the environmental pillar and its impact on efficiency and effectiveness : the environmental dimension of the institutional framework of sustainable development (IFSD), *Issue Brief* No. 2 (Nairobi 2011), accessed from www.unep.org/environmentalgovernance/IssuesBriefsontheInstitutionalFramework/tabid/54126/Default.aspx on 14 June 2011.

8. United Nations Environment Programme, "Annotated table of broader IEG reforms in a standardized format", Information Note from the Executive Director of UNEP, presented at the Second meeting of the Consultative Group of Ministers or High-level Representatives on International Environmental Governance, Helsinki, 21-23 November 2010.

9. United Nations General Assembly, *Objectives and Themes of the United Nations Conference on Sustainable Development*, *Report of the Secretary General* (A/CONF.216/7, New York, 2011), accessed from www.uncsd2012.org/index.php?option=com_content&view=article&id=154:secretary-generals-report-on-objectives-and-themes&catid=72:preparatory-committees&Itemid=123 on 5 March 2011.

10. United Nations Environment Programme, "Nairobi-Helsinki Outcome", in Second meeting of the Consultative Group of Ministers or High-level Representatives on International Environmental Governance, Helsinki, 21-23 November 2010 (Nairobi, 2010).

11. United Nations Environment Programme, *Options for Broader Reform of IEG, the Consultative Group of Ministers or High-Level Representatives on Broader IEG Reform* (Nairobi, 17 May 2010).

12. United Nations General Assembly, *Objectives and Themes of the United Nations Conference on Sustainable Development*, *Report of the Secretary General* (A/CONF.216/7 New York, 2011), accessed from www.uncsd2012.org/index.php?option=com_content&view=article&id=154:secretary-generals-report-on-objectives-and-themes&catid=72:preparatory-committees&Itemid=123

13. Solo Message, issued by the High Level Dialogue on the Institutional Framework for Sustainable Development, Solo, Indonesia 19-21 July 2011.

14. World Trade Organization, *Analytical Index: Sanitary and Phytosanitary Measures. Agreement on Sanitary and Phytosanitary Measures Article 2.2*, accessed from www.wto.org/english/res_e/booksp_e/analytic_index_e/sps_01_e.htm)

15. Convention on Biological Diversity, *The Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Preamble,* accessed from http://bch.cbd.int/protocol/text/article.shtml?a=cpb-00

16. United Nations, *Report of the United Nations Conference on Environment and Development, Annex I Rio Declaration on Environment and Development* (New York, 2002), accessed from www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

17. Transitional Committee for the design of the Green Climate Fund, accessed from http://unfccc.int/cooperation_and_support/financial_mechanism/green_climate_fund/items/5869.php

18. United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Reduction – A Synthesis for Policy Makers* (Nairobi, 2011).

19. G-20, "Leaders' Statement", in *The Pittsburgh Summit*, September 24-25 2009, accessed from www.g20.org/Documents/pittsburgh_summit_leaders_statement_250909.pdf

20. Organisation for Economic Co-operation and Development, *Towards Green Growth* (Paris, 2011). This strategy provides a practical framework for governments in developed and developing countries to seize opportunities that arise when the economy and the environment work together. The Green Growth Strategy has four elements: (i) Towards Green Growth; (ii) Towards Green Growth - Monitoring Progress: OECD Indicators; (iii) Tools for Delivering Green Growth; and (iv) Towards green growth: A summary for policy makers, accessed from www.oecd.org/document/10/0,3746,en_2649_37425_47983690_1_1_1_37425,00.html

21. See for example, World Economic Forum, *Global Redesign Initiative*, accessed from http://schwabfound.weforum.org/en/events/ArchivedEvents/GlobalRedesignSummit2010/GlobalRedesignInitiativeReport/index.htm

22. Association of Southeast Asian Nations, *ASEAN Vision 2020*, adopted in Kuala Lumpur on15 December 1997 by the Heads of State/Governments, accessed from www.aseansec.org/2357.htm

23. United Nations University, "National and Regional Approaches in Asia and the Pacific", In *Interlinkages: Synergies and Coordination between Multilateral Environmental Agreements* (Tokyo, 2002).

24. S. Nam, Undated, *Institutionalizing Complex and Ecological Interdependence: Subregional Environment Governance in Asia and the Pacific* (Bangkok, United

Nations Economic and Social Commission for Asia and the Pacific).

25. United Nations, "Regional customs network in support of multilateral environmental agreements in Asia", In *Synergies Success Stories. Enhancing Cooperation and Coordination among the Basel, Rotterdam and Stockholm Conventions* (New York, 2011), accessed from www.basel.int/synergies/success_stories.pdf on 12 May 2011.

26. African, Caribbean and Pacific Group of States Multilateral Environmental Agreements Project, Pacific Hub (SPREP, accessed from www.unep.org/AfricanCaribbeanPacific/MEAs/PacificRegionalHub/index.asp

27. Asian Environmental Compliance and Enforcement Network, *Environmental Compliance and Enforcement in Vietnam: Rapid Assessment* (2005), accessed from www.aecen.org/document.htm

28. Alan Khee-Jin Tan, "Environmental Laws and Institutions in Southeast Asia: A Review of Recent Developments", *Singapore Yearbook of International Law* (2004) vol. VIII, pp. 177–192, accessed from http://law.nus.edu.sg/apcel/docs/Article-SYBIL3-SoutheasiaEnvironment3.pdf

29. The public sector refers to that part of the economy concerned with providing public goods and services. Management of the public sector, that is, the organization of government and the implementation of government policies and programmes, is done through a country's public administration system. The public sector is principally controlled by national and/or subnational governments, albeit that in most countries overlaps and partnerships with the private sector and civil society exist, mainly in the planning and delivery of goods and services. For the purposes of this report, governance refers to the exercise of power/authority in the management of a country's economic, natural and social resources.

30. R.W. Kates, T.M. Parri, and A.A. Leiserowitz, "What is sustainable development? Goals, indicators, values and practice", *Environment* (2005) vol. 4, No. 3, pp. 8–21.

31. L. Lebel, J.M. Anderies, B. Campbell, C. Folke, S. Hatfield-Dodds, T. Hughes and J. Wilson, "Governance and the capacity to manage resilience in regional social-ecological systems", *Ecology and Society* (2006) vol. 11, No. 1, article 19 (online), accessed from www.ecologyandsociety.org/vol11/iss1/art19/.

32. A. Smith, A. Stirling and F. Berkhout, "The governance of sustainable socio-technical transitions", *Research Policy* (2005) vol. 34, pp. 1491–1510.

33. R. Meinzen-Dick, "Beyond panaceas in water institutions", *Proceedings of the National Academy of Sciences* (2007) vol. 104, No. 39, pp. 15200–15205.

34. E. Ostrom, M.A. Janssen and J.M. Anderies, "Going beyond panaceas", *Proceedings of the National Academy of Sciences* (2007) vol, 104, No. 39, pp. 15176–15178.

35. D. Huitema, L. Lebel and S. Meijerink, "The strategies of policy entrepreneurs in nine European and Asian water transitions", Working Paper presented at the ASEM WaterNet Final Conference, Changsha, China, 17-19 November 2009.

36. P. Olsson, L.H. Gunderson, S.R. Carpenter, P. Ryan, L. Lebel, C. Folke and C.S. Holling, "Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems", *Ecology and Society* (2006) vol. 11, No. 1, article 18 (online), accessed from www.ecologyandsociety.org/vol11/iss1/art18/.

37. C. Pahl-Wostl, "A conceptual framework for analyzing adaptive capacity and multi-level learning processes in resource governance regimes", *Global Environmental Change* (2009) vol. 19, pp. 345–365.

38. M.A. Hajer and H. Wagenaar, eds., *Deliberative Policy Analysis: Understanding Governance in the Network Society* (Cambridge, Cambridge University Press, 2003).

39. J.S. Dryzek, "Transnational democracy", *The Journal of Political Philosophy* (1999) vol. 7, No. 1, pp. 30–51.

40. L. Lebel, T. Grothmann and B. Siebenhuner, "The role of social learning in adaptiveness: insights from water management", *International Environmental Agreements* (2010) vol. 10, pp. 333–353.

41. P. Evans, ed., *Livable cities? Urban Struggles for Livelihood and Sustainability* (Berkeley, University of California Press, 2002).

42. K.-S. Yap and L. Lebel, "Incomplete urbanization", In L. Lebel and others, eds., *Critical states: Environmental Challenges to Development in Monsoon Asia* (Selangor, Malaysia, Strategic Information and Research Development Centre, 2009), pp. 35–50.

43. A. Hasan, "The Urban Resource Centre, Karachi", *Environment and Urbanization* (2007) Vol. 19, pp. 275–292.

44. A. Hasan, "The Urban Resource Centre, Karachi", *Environment and Urbanization* (2007) vol. 19, pp. 275–292.

45. A. Hasan, "Land, CBOs and the Karachi circular railway", *Environment and Urbanization* (2009) vol. 21, pp. 331–345.

46. J. Dryzek, "Legitimacy and economy in deliberative democracy", *Political Theory* (2001) vol. 29, No. 5, pp. 651–669.

47. L. Lebel, Adapting to climate change", *Global Asia* (2007) vol. 2, No. 3, pp. 15–21.

48. United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Reduction – A Synthesis for Policy Makers* (Nairobi, United Nations Environment Programme, 2011).

Chapter 5

1. World Economic Forum, *Global Risks 2011 Sixth Edition, an Initiative of the Risk Response Network*, accessed from http://riskreport.weforum.org/ on 2 February 2011.
2. D. Swanson and S. Bhadwal, eds., *Creating Adaptive Policies: a Guide for Policy-Making in an Uncertain World* (New Delhi, Sage Publications, 2009).
3. C. Folke, S. Carpenter, T. Elmqvist, L. Gunderson, C.S. Holling, B. Walker, J. Bengtsson, F. Berkes, J. Colding, K. Danell, M. Falkenmark, L. Gordon, R. Kasperson, N. Kautsky, A. Kinzig, S. Levin, K-G. Mäler, F. Moberg, L. Ohlsson, P. Olsson, E. Ostrom, W. Reid, J. Rockström, H. Savenije and U. Svedin, "Resilience and sustainable development: building adaptive capacity in a world of transformation", scientific background paper on resilience for the process of the World Summit on Sustainable Development, on behalf of the Environmental Advisory Council to the Swedish Government (2002).
4. B. Blankespoor, S. Dasgupta, B. Laplante and D. Wheeler, "The economics of adaptation to extreme weather events in developing countries", *World Bank Policy Research Working Paper* 5342 (Washington, D.C., 2010).
5. D. Swanson and S. Bhadwal, eds., *Creating Adaptive Policies: a Guide for Policy-Making in an Uncertain World* (New Delhi, Sage Publications, 2009).
6. D. Cash, W.C. Clark, F. Alcock, N.M. Dickson, N. Eckley, D.H. Guston, J. Jager and R.B. Mitchell, "Knowledge systems for sustainable development", *Proceedings of the National Academy of Sciences* (2003), vol. 100, No. 14, pp. 8086–8091.
7. C. Pahl-Wostl, "Transitions towards adaptive management of water facing climate and global change", *Water Resources Management* (2007) vol. 21, pp. 49–62.
8. S. Hallegatte, "Strategies to adapt to an uncertain climate change", *Global Environmental Change* (2009) vol. 19, pp. 240–247.
9. D.W. Cash, J.C. Borck and A.G. Patt, "Countering the loading-dock approach to linking science and decision making", *Science, Technology and Human Values* (2006) vol. 31, No. 4, pp. 465–494.
10. H. Meinke, R. Nelson, P. Kokic, R. Stone, R. Selvaraju and W. Baethgen, "Actionable climate knowledge: from analysis to synthesis", *Climate Research* (2006), vol. 33, pp. 101–110.
11. L. van Kerkhoff and L. Lebel, "Linking knowledge and action for sustainable development", *Annual Review of Environment and Resources* (2006) vol. 31, pp. 445–477.
12. K.-S. Yap and L. Lebel, "Incomplete urbanization", in L. Lebel and others, eds., *Critical States: Environmental Challenges to Development in Monsoon Asia* (Selangor, Strategic Information and Research Development Centre, 2009), p. 35–50.
13. M.A. Hajer and H. Wagenaar, eds., *Deliberative Policy Analysis: Understanding Governance in the Network Society* (Cambridge, Cambridge University Press, 2003), 307 pp.
14. D. Armitage, R. Plummer, F. Berkes, R. Arthur, A. Charles, I. Davidson-Hunt, A. Diduck, N. Doubleday, D. Johnson, M. Marschke, P. McConney, E. Pinkerton and E.K. Wollenberg, "Adaptive co-management for social-ecological complexity", *Frontiers in Ecology and Environment* (2009) vol. 7, No. 2, pp. 95–102.
15. F. Berkes, "From community-based resource management to complex systems", *Ecology and Society* (2006) vol. 11, No. 1, p. 45.
16. D. Armitage, R. Plummer, F. Berkes, R. Arthur, A. Charles, I. Davidson-Hunt, A. Diduck, N. Doubleday, D. Johnson, M. Marschke, P. McConney, E. Pinkerton and E.K. Wollenberg, "Adaptive co-management for social-ecological complexity", *Frontiers in Ecology and Environment* (2009) vol. 7, No. 2, pp. 95–102.
17. F. Berkes, "Evolution of co-management: role of knowledge generation, bridging organizations and social learning", *Journal of Environmental Management* (2009) vol. 90, pp. 1692–1702.
18. D. Armitage, R. Plummer, F. Berkes, R. Arthur, A. Charles, I. Davidson-Hunt, A. Diduck, N. Doubleday, D. Johnson, M. Marschke, P. McConney, E. Pinkerton and E.K. Wollenberg, "Adaptive co-management for social-ecological complexity", *Frontiers in Ecology and Environment* (2009) vol. 7, No. 2, pp. 95–102.
19. P. Olsson, C. Folke, V. Galaz, T. Hahn and L. Schultz, "Enhancing the fit through adaptive co-management: creating and maintaining bridging functions for matching scales in the Kristianstads Vattenrike Biosphere Reserve, Sweden", *Ecology and Society* (2007) vol. 12, No. 1, p. 28, accessed from www.ecologyandsociety.org/vol12/iss1/art28/.
20. F. Berkes, "Evolution of co-management: role of knowledge generation, bridging organizations and social learning", *Journal of Environmental Management* (2009) vol. 90, pp. 1692–1702.
21. Enrique Ibarra Gene and Arif Aliadi, "REDD (Reducing emissions from deforestation and forest degradation): mitigation, adaptation and the resilience of local livelihoods", *Asian Security Initiative Policy Series, Working Paper* (2010) No. 8 (Singapore, Center for Non-traditional Security Studies), accessed from http://www.rsis.edu.sg/NTS/resources/research_papers/MacArthur%20Working%20Paper_Enrique_and_Arif.pdf on 6 March 2011.
22. J. Dore, "Mekong region water-related MSPs: unfulfilled potential', in J. Warner, ed., *Multi-stakeholder Platforms for Integrated Water Management* (Aldershot, Ashgate, 2007), pp. 205–234.
23. J.S. Dryzek, *Deliberative Democracy and Beyond: Liberals, Critics, Contestations* (Oxford, Oxford University Press, 2000).
24. F. Molle, T. Foran and M. Kakonen, eds., *Contested Waterscapes in the Mekong Region: Hydropower,*

Livelihoods and Governance (London, Earthscan, 2009), 426 pp.

25. C. Pahl-Wostl, "A conceptual framework for analyzing adaptive capacity and multi-level learning processes in resource governance regime", *Global Environmental Change* (2009) vol. 19, pp. 345–365.

26. Australian Government, Department of the Environment and Heritage, *RELaw Assist*, *Renewable energy law in China – issues paper* (Canberra, June 2007), accessed from http://cmsdata.iucn.org/downloads/cel10_mathews.pdf?bcsi_scan_9688B637A46568DB=0&bcsi_scan_filename=cel10_mathews.pdf

27. Asian and Pacific Centre for Transfer of Technology of the United Nations and Economic and Social Commission for Asia and the Pacific (ESCAP), *Indonesia Renewable Energy Report* (Bangkok, ESCAP, undated), accessed from http://recap.apctt.org/Countries/PDF/Indonesia_CountryReport.pdf?bcsi_scan_9688B637A46568DB=0&bcsi_scan_filename=Indonesia_CountryReport.pdf on 28 February 2011.

28. Indonesia, Ministry of New and Renewable Energy, Office Memorandum No.1/1/2005-R&D, 18 October 2010, accessed from www.mnre.gov.in/r&d/om-rnd18102010.pdf on 5 FEbruary 2011.

29. "Presentation on country report: energy and climate change in Viet Nam", presented at the Workshop on Energy and Climate Change, Bangkok, 26–27 March 2009, organized by the Asian Development Bank.

30. A brief presentation on The Electricity Malaysia Supply Industry. Available: ww.iea.org/Textbase/work/2008/bangkok/malaysia.pdf (accessed on 4 July 2009).

31. "The present value of the total cost of building and operating a generating plant over its economic life, converted to equal annual payments. Costs are converted to real dollars (that is, adjusted to remove the impact of inflation). United States Energy Information Administration, accessed from www.eia.doe.gov/glossary/glossary_l.htm

32. D. Creech, E. Metzger, S. Putt del Pino and J. Wilson, *Local Clean Power* (Washington, D.C., World Resources Institute, Southface, and Southern Alliance for Clean Energy, 2009), accessed from www.wri.org/publication/southeast-energy-policy on 22 April 2010.

33. Extending the grid from centralized power plants has built-in system losses of 4-6% in state-of-the-art transmission and distribution systems.

34. Asian Development Bank, *Improving Energy Security and Reducing Carbon Intensity in Asia and the Pacific* (Manila, 2009).

35. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds). *Climate Change 2007: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., accessed at http://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-p-z.html on 20 August 2008.

36. R.V. Cruz and others, "Asia", Chapter 10 in: *Climate change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, Cambridge University Press (2007), pp. 469–506.

37. United Nations International Strategy for Disaster Reduction (ISDR), *Global Assessment Report on Disaster Risk Reduction* (Geneva, 2009).

38. Climate variability is a naturally occurring phenomenon and can be manifested in many ways, such as through the El Niño-Southern Oscillation (ENSO) cycle or through decadal and seasonal shifts in wind patterns and sea surface temperatures, which can cause changes in hurricane frequency. Climate change is an influencing factor in climate variability.

39. M.E. Hellmuth, A. Moorhead, M.C. Thomson and J. Williams, eds., *Climate Risk Management in Africa: Learning from Practice* (New York, Columbia University, International Research Institute for Climate and Society (IRI), 2007).

40. A.G. Patt, L. Ogallo and M.E. Hellmuth, "Learning from ten years of climate outlook forums in Africa", *Science* (2007) vol. 318, No. 5847, pp. 49–50.

41. Climate Investment Funds, "Developing Nepal's strategic program for climate resilience (SPCR): prioritisation planning process, consultative draft, 20 November 2010", accessed from www.ppcrnepal.gov.np/files-download/spcr/final%20report.pdf on 14 March 2011.

42. N. Abel and A. Langston, "Evolution of a social-ecological system: adaptation and resilience in the New South Wales rangelands 1850 to 2020", draft 10/1, accessed from www.cse.csiro.au/research/nswrangelands/pubs/popular_articles/Draft_Paper.pdf on 1 March 2011,

43. Secretariat of the Convention on Biological Diversity, "Connecting biodiversity and climate change mitigation and adaptation: report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change", *Technical Series* (2009) No. 41, 126 pp.

44. Swiss Re, *Ethiopia – Can Insurance Reach the Extreme Poor?* (Zurich, 2009), accessed from www.swissre.com/rethinking/climate/ethiopia_can_insurance_reach_the_chronically_poor.html on 17 April 2010.

Annex

1. For a detailed discussion, see Peter Bartelmus. *Green accounting* (Aldershot , Ashgate Publishing, 2003).

2. M. Fischer-Kowalski, H. Haberl and H. Payer, "Indicators for society's metabolism and for the intensity of 'colonizing nature'", in B. Moldan and others, eds.,

*Sustainability Indicators: a Report on the Project on Indicators of Sustainable Development (*Chichester, John Wiley & Sons, 1997).

3. United Nations, *Integrated Environmental and Economic Accounting: an Operational Manual* (New York, 2000).

4. The two main sources of guidelines for accounting for material use at a national level are H. Weisz and others, Economy-wide material flow accounting "a compilation guide" (Luxembourg, Eurostat, 2007); and the three volumes and synthesis report *Measuring Material Flows and Resource Productivity* (Paris, Organisation for Economic Co-Operation and Development, 2008).

5. This methodology has also been used by the European Statistical Office to produce a European dataset, which is available online. Material flow accounts have also been developed for individual countries in the Asian and Pacific region, including Australia, China, Japan and the Philippines.

6. A number of countries and regions have implemented policies to foster resource efficiency and low carbon development. A detailed list is presented in Chapter 3.

7. European Environment Agency, *Material Flow-Based Indicators in Environmental Reporting* (Luxembourg; Office for Official Publications of the European Communities,1999).

8. H. Weisz, F. Krausmann, C. Amann, N. Eisenmenger, K. H. Erb, K. Hubacek and M. Fischer-Kowalski, "The physical economy of the European Union: cross-country comparison and determinants of material consumption", *Ecological Economics* (2006) vol. 58, No. 4, pp. 676–698.

9. United Nations Environment Programme, *Resource Efficiency: Economics and Outlook for Asia and the Pacific* (Canberra, CSIRO Publishing, 2011).

10. Commonwealth Scientific and Industrial Research Organisation and United Nations Environment Programme, *Asia-Pacific Material Flow Database*, accessed from www.csiro.au/AsiaPacificMaterialFlows on 12 January 2011.

This report—*Green Growth, Resources, and Resilience*—describes an evolving policy landscape characterized by a changing economic reality, rising demand for resources, increasingly apparent impacts of environmental and climate change, and increased risk and uncertainty. The report provides new insights into Asian and Pacific resource use trends and outlines key actions, including reforming economic incentives and promoting more inclusive and adaptive governance approaches, that governments can pursue to help bring economic growth strategies in closer alignment with the objective of sustainable development. It also provides examples of strategies for improving resilience to help deal with the increasing levels of risk faced by societies and economies.

The report is the product of a combined effort by three institutions: the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the Asian Development Bank (ADB) and the United Nations Environment Programme (UNEP). It is the sixth in a series of reports prepared by ESCAP for successive Ministerial Conferences on Environment and Development in Asia and the Pacific, and is the third in ADB's Asian Environment Outlook series. It is also in line with the mandate of UNEP to keep the state of the environment under review.

The report provides timely support to policymakers and other stakeholders as they prepare for the 2012 United Nations Conference on Sustainable Development (Rio +20) and as they continue work to address persistent and emerging challenges on their way to more sustainable development.

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