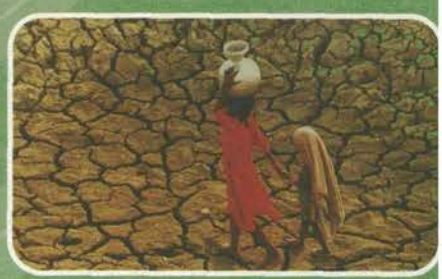
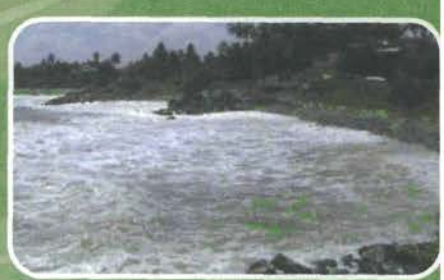
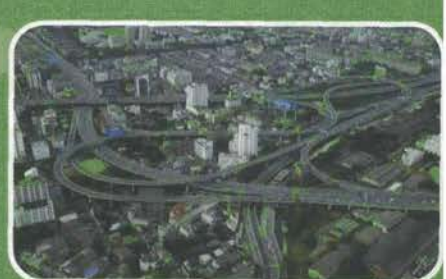
Asia-Pacific Environment Outlook 2







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Asia - Pacific Environment Outlook 2

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FOREWORD

Executive Director
United Nations Environment Programme

The Asia-Pacific Environment Outlook is published by UNEP periodically to present the state of environment and its trend in the region. The report aims to critically review the existing status of the environment, the driving forces for changes, and the existing set of policy initiatives undertaken to confront environmental challenges.

This report analyzes the state of changes of environment and natural resources that took place over the last hundred years. Time series data on land, forest, biodiversity, water, marine and atmosphere revealed the alarming rate of deterioration of environment at the local, subregional and regional levels. The cause-effect relationships for the changes are reviewed in depth.

This report also highlights the various driving forces that brought about the transformation in the region. The remarkable developments in economic and social conditions, as well as rapid urbanization have enabled to raise the living standards of people, but it has embarked enormous pressure on the natural resources and environment in the region.

This report assesses the effectiveness of current policy initiatives to address the emerging environmental issues at the local, subregional and regional levels. Many countries have adopted various policy initiatives to make environmental conservation an integral feature of development plans. The impacts of laws and institutions, cleaner production, regional cooperation, economic instruments, public participation, environmental education, and environmental agreements to promote environmental conservation are illustrated in the report with specific examples.

Asia and the Pacific region is expected to witness a rapid economic growth in the future, fueled by industrialization, trade and investment. This report attempts to measure the future development scenario and its possible impacts on environmental conditions. A set of recomendations are proposed in order to improve the trend of environmental and social conditions. The report recommends the improved governance as well as policy initiatives, including political will, partnership between government, business and civil society, and regional cooperation, in order to make the Asia-Pacific region economically sustainable, environmentally sound and socially equitable.

UNEP hopes that the Asia-Pacific Environment Outlook 2 would be a useful document for government, non-government, private, regional and international organizations in the pursuit of developing policies, strategies and action plans. UNEP gratefully acknowledge the contribution of institutes and individuals in the preparation of the report, in particular the valuable support and input provided by the Collaborating Centres.

Klaus Töpfer
United Nations Under-Secretary General and Executive Director
United Nations Environment Programme
December 2002

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We are also grateful to Mr. Raghunath Rajamani, Ex-Secretary, Ministry of Environment and Forest, India and our sub-regional partners (SACEP, ICIMOD, MRC, ASEAN and SPREP) for facilitating the regional consultation process.

We greatly acknowledge the contribution of GEO collaborating centres (AIT, BCAS, NIES, SPREP, SEPA, TEI, and TERI) in the preparation of this report.

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In addition, we would like to thank the UNEP GEO Team at Nairobi (Marion Cheatle, Miriam Schomaker, Megumi Seki, Veerle Vandeweerd, Munyaradzi Chenje, Volodymyr Demkine, Anna Stabrawa and Kaveh Zahedi) for their continued support and advice in the preparation of this report.

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Executive Summary

Executive Summary

The Asia-Pacific region is in the midst of an unprecedented economic and social transformation. Rapid industrialization and high rates of economic growth have changed virtually every dimension of life. During the last decade, the fastest growing economies in the region were in East Asia and Southeast Asia with a per capita GDP growth rate of 6 percent and 3.8 percent, respectively, compared to the world's average growth rate of 1.9 percent. During the same period, the share of people working in industry grew from around 15 percent to 21 percent. However, the benefits of this economic growth have not filtered down to all levels of society. In most countries in the region, the quality of life generally remains poor. About 75 percent of the world's poor live in Asia. South Asia alone has over 50 percent of the world's population living below absolute poverty levels. At least one in three Asians has no access to safe drinking water and at least one in two has no access to sanitation. The average cereal consumption remains at one-third of that in developed countries and average food availability, as a proportion of required daily intake, is low in many countries. Literacy rates remain low, particularly for women.

With about 58 percent of the world's population depending upon only about a quarter of the world's land area, the pressure on the land resources of the region is great. South Asia has the highest population density in the region with about 186 persons per square kilometer. As the population grows at rates higher than the world average of 1.4 percent, particularly in South Asia (with 1.9 percent) and Southeast Asia (with 1.7 percent), the number of landless households has also increased. The resulting poverty, particularly in the rural areas, has led to significant rates of rural-urban migration. The regional rate of increase in urban population of 46.7 percent is significantly higher than the global average of 29.3 percent, although the regional percentage of urban population of 34.1 percent remains lower than the global average of 44.8 percent. While population growth rates have declined in recent years, a large portion of the population is in the pre-reproductive age groups, particularly in parts of South and Southeast Asia. This could lead to sharp increases in population growth in the near future.

The combined impact of high population density and growth, rapid industrialization and urbanization, and widespread poverty is evident in the depletion of the region's natural resources and degradation of the environment. The present trend of economic development has put enormous pressure on environment in the form of water shortage, air and water pollution, biodiversity loss and depletion of forests, and land degradation. Overall estimates of the economic costs of environmental degradation in Asia range from one to nine percent of the country's GNP. There is an urgent need to reverse the trend of environmental and social conditions through appropriate policy measures and developing strong partnership between government, business and civil society.

LAND AND FOOD

At the turn of the century, most countries in the region were mainly agricultural, practicing traditional, subsistence farming, including shifting cultivation and nomadic livestock grazing. As the population increased, the need for more food imposed more pressure on land resources. Thus the area of cropland expanded from 210 million hectares in 1900 to 470 million hectares in 1994, largely at the expense of forests and woodlands. Today there is less land per person in the Asia-Pacific region than in other regions of the world. In 1992, the region had only 0.3 hectare of agricultural land per person, compared to 1.6 in the rest of the developing world and 1.4 in OECD countries. In 1994, the region (excluding Oceania) had 0.18 hectare of cropland per capita compared to 0.79 in North America, 0.43 in Europe, and 0.27 in Africa.

The region as a whole is a net food importer. In 1991, for example, the net cost of imports amounted to US$7.3 billion. In 1996, the per capita cereal production in the region (excluding Oceania with 1.24 metric tonnes per capita) was only 0.28 metric tonnes compared to 1.33 in North America and 0.54 in Europe. As agricultural production increases more slowly than in the past, the region will increasingly rely on imported food. By 2010, Asia's share of world cereal imports may rise to about 42 percent from its

current level of 33 percent, and this may put pressure on world food balances and affect world food prices.

The combined effect of extensive deforestation and unsustainable agriculture, together with inadequate soil conservation, cultivation of steep slopes, overgrazing and rapid urban and industrial growth, has greatly affected land resources. The unsustainable use of irrigated agriculture with excessive agrochemical inputs has degraded existing arable lands and resulted in vast expanses of salinized, acidified and waterlogged soils. Thus of the world's 1.9 billion hectares of land affected by soil degradation during the last 45 years, the largest area (around 550 million hectares) is in the Asia-Pacific region. This constitutes about 19 percent of the region's total vegetated land. In addition, prime agricultural land has been lost to urban, industrial and transport infrastructure, particularly in coastal areas.

There is an expressed need to reverse the trends of land degradation through effective strategies and policy responses, include: a) introducing policy reforms for effective and efficient management of land and water resources; b) review and strengthen National Action Plans for combating desertification and land degradation; c) prepare National Action Plan on food security; d) emphasize on implementation of integrated land and water management projects; e) develop capacity building at the national level to assess the extent of land degradation and desertification; f) regional cooperation on capacity building, and networking on assessment and reporting, improved irrigation, pest management, and water shed management; g) promote partnership between government, business and civil society to address the issues of land degradation and desertification;and h) establishment and operationalization of the Convention to Combat Desertification. (CCD).

FORESTS

The Asia-Pacific region has 555 million hectares of forest remaining amounting to about 13 percent of the world's total. This is not enough to meet the growing needs of the increasing population and domestic wood shortages are beginning to appear. The region has only about 0.17 hectare of forest per capita, or less than one-third the world average of 0.61 hectare per capita. South Asia has only 0.08 hectare of forest per capita, the lowest in the region. Southeast Asia has 0.46 hectare of forest per capita and the highest forest cover in the region that is about 52 percent of the total land area as compared to 47 percent percent in South America and 20 percent for Asia as a whole. But it has the highest rate of deforestation in the region.

In the last century, primary forests in the Asia-Pacific region were depleted by a combination of causes including fuelwood harvesting, commercial logging, forest fires, and land clearance for agriculture, infrastructure and settlement. Between 1850 and 1980, nearly 24 percent of forests (224 million hectares) were removed thereby destroying two-thirds of wildlife habitats. With the exception of China, rates of deforestation increased significantly from 1930 onwards reaching a level of about one to two percent per year. The annual deforestation rate of tropical forests doubled from an average of 2 million hectares during the period 1976-81 to 3.9 million hectares in 1981-90. This represented the highest annual rate of deforestation (1.2 percent) among the tropical regions of the world during 1981-90 and accounted for one-third (3.9 out of 15.4 million hectares) of net deforestation worldwide. During the 1980s, forested areas in the region decreased by nearly 15 percent, or an annual average of 1.6 percent, more than double the rate of forest depletion elsewhere in the world. However, the estimated rate for 1990-95 was slightly lower at 1.1 percent. Six countries (China, Indonesia, Malaysia, Myanmar, Philippines, and Thailand) accounted for 75 percent of deforestation in the region.

Commercial logging contributes significantly to deforestation rates and around 80 million cubic metres of roundwood are cut as commercial timber annually. At current rates of harvesting, the remaining timber reserves in Asia are estimated to last for less than 40 years and an area of about 50 million hectares may well be deforested by 2005. The depletion of timber reserves, coupled with increased domestic wood consumption, is likely to reduce Asia's dominance of world trade in tropical hardwoods. But while the region suffers the fastest rate of conversion of natural forests in the world, it also can take pride in its record of forest plantation establishment. The region stands as the leading region for forest plantations among the developing countries of the world with nine of the top 15 developing countries for forest plantation establishment.

BIODIVERSITY

The Asia-Pacific region is rich in biodiversity. Encompassing parts of three of the world's eight biogeographic divisions, namely the Palaearctic, Indo-Malayan, and Oceanian realms, the region has the

world's highest mountain system (Himalayas), the second largest rainforest complex, and more than half of the world's coral reefs. Of the seventeen identified 'mega-diverse' countries in the world which account for more than two-thirds of the earths entire biological resources, seven are in the region, namely Australia, China, India, Indonesia, Malaysia, Philippines, and Papua New Guinea. The region has a wealth of over 165,000 vascular plant species. China is ranked third in the world for its richness in biodiversity with over 30,000 plants and over 6300 vertebrates. Indonesia is among the five top countries of the world with over 30,000 plant diversity. Approximately 120 million hectares of wetlands are recognized internationally of which 85 percent are in eight Asian countries, namely Bangladesh, Cambodia, China, India, Indonesia, Myanmar, Papua New Guinea, and Viet Nam.

This biodiversity is under serious threat. The biological resources of the region are increasingly exploited for international trade and to support the region's growing population. Natural products, particularly timber and fish, are exported to developed countries and arable land has been expanded into primary forests, wetlands and grasslands to increase agricultural production. As a result, about two-thirds of Asian wildlife habitats have been destroyed and an estimated 70 percent of the major vegetation types in the Indo-Malayan realm (the region covering South Asia, Mekong and Southeast Asia) have been lost, with a possible associated loss of up to 15 percent of terrestrial species. Dry and moist forests have suffered 73 percent and 69 percent losses, respectively, and wetlands, marsh and mangroves have been reduced by 55 percent. With only about 10-30 percent of natural habitats left in many countries of the region, any further decrease could have much more serious consequences for biodiversity than the initial stage, when 50 percent of the original habitat was lost. It is projected that increasing pressure from population growth, liberal economic policies, and land use changes will continue to threaten the region's biodiversity. Indeed some scientists predict that a mass extinction of species could take place within the next 20-25 years if current trends continue.

The following steps need to be taken urgently in order to protect the biodiversity: a) prepare and/or review Biodiversity Action Plans at the national level including forestry, grasslands, coastal and marine areas, and river and wetland; b) prepare an action plan to protect critical areas and species; c) Prepare or update the database on biodiversity to support strengthened planning and management of protected areas and biodiversity conservation; d) Promote the implementation of the Convention on Biological Diversity (CBD) and the early ratification of the bio-safety protocol; e) encourage increased adherence to CITES; f) develop national mechanism for the protection of traditional knowledge, including intellectual property right; g) ensure stakeholders participation including participation of women, community based organizations, user groups and the private sectors in biodiversity conservation; h) promote community forest management at the national level to cover specific degraded forests; I) strengthen capacity building in assessment, conservation and research for management of forest and biodiversity; and j) promote subregional and regional cooperation on training, information sharing, and networking of protection and management of forest and biodiversity.

FRESHWATER

During the last century, freshwater withdrawals from rivers, lakes, reservoirs and underground aquifers in the region increased from 600 cubic kms in 1900 to approximately 5,000 cubic kms in the mid-1980s. This was higher than in any other region of the world. The largest increase in demand was for agricultural use accounting for 86 percent of the total. But contamination by pollutants has seriously reduced the availability of clean water. From 10,000 cubic metres in 1950, the annual per capita availability of freshwater in the developing countries of the region was reduced to only 4,200 cubic metres in the 1990s. This has resulted from a combination of factors including saline intrusion, discharge of sewage and industrial effluents, and urban and agricultural runoff. Consequently, the region has more lakes and reservoirs with eutrophication problems (54 percent) than Europe (53 percent), North America (48 percent), South America (41 percent) and Africa (28 percent). Asian rivers also account for nearly 50 percent of the total sediment load (13.5 billion tonnes per year) transported by the world's rivers. Since the late 1970s, the level of suspended solids in Asia's rivers has almost quadrupled, containing 4 times the world average and 20 times OECD levels.

The region has a poor record with regard to safe water supply. One in three Asians has no access to safe drinking water source that operates for at least part of the day within 200 meters of the home. Almost one in two Asians has no access to sanitation services and only 10 percent of sewage is treated at primary level. Biochemical oxygen demand (BOD) in Asian rivers is 1.4 times the world average and 1.5 times OECD level. They contain three times as much bacteria from human

waste (faecal coliform) than the world average and more than ten times OECD guidelines. The reported median faecal coliform count is 50 times higher than WHO guidelines. Consequently, the region accounts for more than 40 percent of the total global diarrhea episodes and reports more than 500,000 infant deaths a year due to dirty water and poor sanitation. Asia's surface water also contains 20 times more lead than surface waters in OECD countries.

With current levels of population growth, demand for water will increase throughout the region up to and beyond the next century, intensifying the problems of scarcity. Freshwater demand will grow fastest in the urban and industrial sectors. In most countries, urban populations will probably triple in the next four decades resulting in a five-fold increase in domestic demand for water. Industrialization will further intensify demand and exacerbate the problems of scarcity and deteriorating quality, especially in countries prone to droughts and desertification. As a consequence, a major freshwater issue in many countries in the region will be the equitable allocation of scarce water resources among competing sectors.

The following measures need to be taken to address the water issues in the region: a) formulate or review national water policy to address issues related to water uses, water security, and management of water ecosystem; b) Establish or strengthen regulatory framework for protection and management of water resources and develop institutional mechanism to enforce legal provisions; c) promotion of integrated water resource management through strategic planning and management, effective demand management, better public participation, and improved institutional, legal and policy frameworks; d) increase availability of freshwater through introduction of cleaner technology in agriculture, industrial and other water consuming sectors; e) introduce market based pricing for demand management and efficient uses of water; f) establish a realistic water budget through proper inventory of demand, supply, and availability of surface and ground water; and g) capacity building of human resources in the area of water resource development and management, including water quality monitoring, water reuse and recycling, assessment techniques, database management, and sewage treatments.

MARINE AND COASTAL AREAS

The Asia-Pacific region has more coastline than any other region in the world and around a quarter of the world's 75 largest cities are situated along this coastline. Since the 1980s marine fisheries production has increased faster in the Asia-Pacific region than anywhere in the world. In 1992, it grew at 2.8 percent compared with the world growth rate of 1.9 percent. Eight countries from the Asia-Pacific were among the world's top 15 fishing nations. During the period 1993-95, the region accounted for approximately 45.8 percent of the world total fish catch. However, by the early 1990s, in many sub-regions, the traditional marine fish stocks had reached full exploitation and, in many areas, over-fishing was already threatening the diversity and quantity of fish. Aquaculture production also continued to increase over the last decade and contributed nearly one-quarter of Asia's total fish supply. In 1992, the Asia-Pacific region provided 87 percent of global aquaculture produce.

Over the past decade, the situation in some coastal zones has improved but, by and large, population growth, rapid coastal urbanization and industrial expansion, and the growth in trade in fisheries resources have adversely affected coastal and marine resources. In addition, pollution from intensified agricultural practices and the expansion of aquaculture production at the expense of mangrove forests have increased coastal and estuarine sedimentation and degradation. The uncontrolled expansion of aquaculture developments contributed to the further destruction of mangrove forests, conversion of wetland habitats, introduction of exotic species, increased use of chemicals, degradation of water quality, and discharge of nutrients and other wastes. This adversely affected 90 percent of fish species that depend on coastal habitats at some period in their lives. In addition, the widespread felling of mangrove forests reduced coastal protection from cyclones and storm surges, increased seawater intrusion and acidified surface waters.

It is projected that coastal pollution and loss of marine resources will increase over the next decade. Aquaculture production will be increasingly important to the region since many marine fish stocks have reached their maximum exploitative level. In the year 2000, nearly half of the world's coastal population was concentrated in urban conglomerates along the shores of Asia. Untreated or partially treated effluents from these rapidly growing cities will continue to constitute a major treat to the marine environment and biodiversity.

The measures proposed for priority action included: a) develop or review integrated coastal zone management plan for management and use of coastal resources; b) develop database and mapping on coastal and marine environment and resources; c) review and

strengthen environmental legislations and regulations to control pollution of common sources; d) implement regional action plan for land based sources of pollution under the global programme of action for the protection of the marine environment from land-based activities; e) establish monitoring system to assess the health of marine system, pressure on coral reefs, and water quality parameters; f) prepare a master plan for environmentally sound coastal tourism; g) integrate environmental and social issues with economic planning and use of economic instruments in protecting coastal and marine environment; h) promote partnership among stakeholders for planning, development and management of the resources of the coastal areas.

ATMOSPHERE

During the last quarter of the century, atmospheric pollution increased significantly in the Asia-Pacific region largely as a result of escalating energy consumption due to rapid economic growth and the more widespread use of motor vehicles. Commercial energy consumption in most parts of the region increased three-fold during the period 1971 to 1990. In 1992, the region, excluding Japan, Australia and New Zealand, accounted for 21 percent of the world's primary commercial energy demand. While annual global energy consumption fell by 1 percent between 1990 and 1993, Asia's energy consumption grew by 6.2 percent. Fossil fuels accounted for about 80 per cent of energy generation in Asia, with coal accounting for about 40 percent. In 1993, the region also accounted for about 41 percent of global coal consumption.

The extent of air pollution varied considerably across Asia but was worse in urban areas and increased most rapidly in developing countries in the region. Between 1970 and 1986, sulfur oxide emissions in Asia increased by 80 percent from 11 to 20 million tonnes of sulfur equivalent, a rate that was four times than other regions. For 22 countries in Asia, total emissions of sulfur dioxide were estimated to be 38 million tonnes in 1990, about 50 percent higher than in either Africa or Latin America but still only one-third the level in industrial countries. Nitrogen oxide emissions from fossil fuel combustion increased by 70 percent from 3 million in 1970 to 5.1 million tonnes of nitrogen equivalent in 1986 but still were significantly less than that of North America and Europe. Since the 1970s industrial emissions of carbon dioxide have grown 60 percent faster in Asia than anywhere else but carbon dioxide emissions per capita remain at less than half of the world average and only 15 percent of the level in OECD countries.

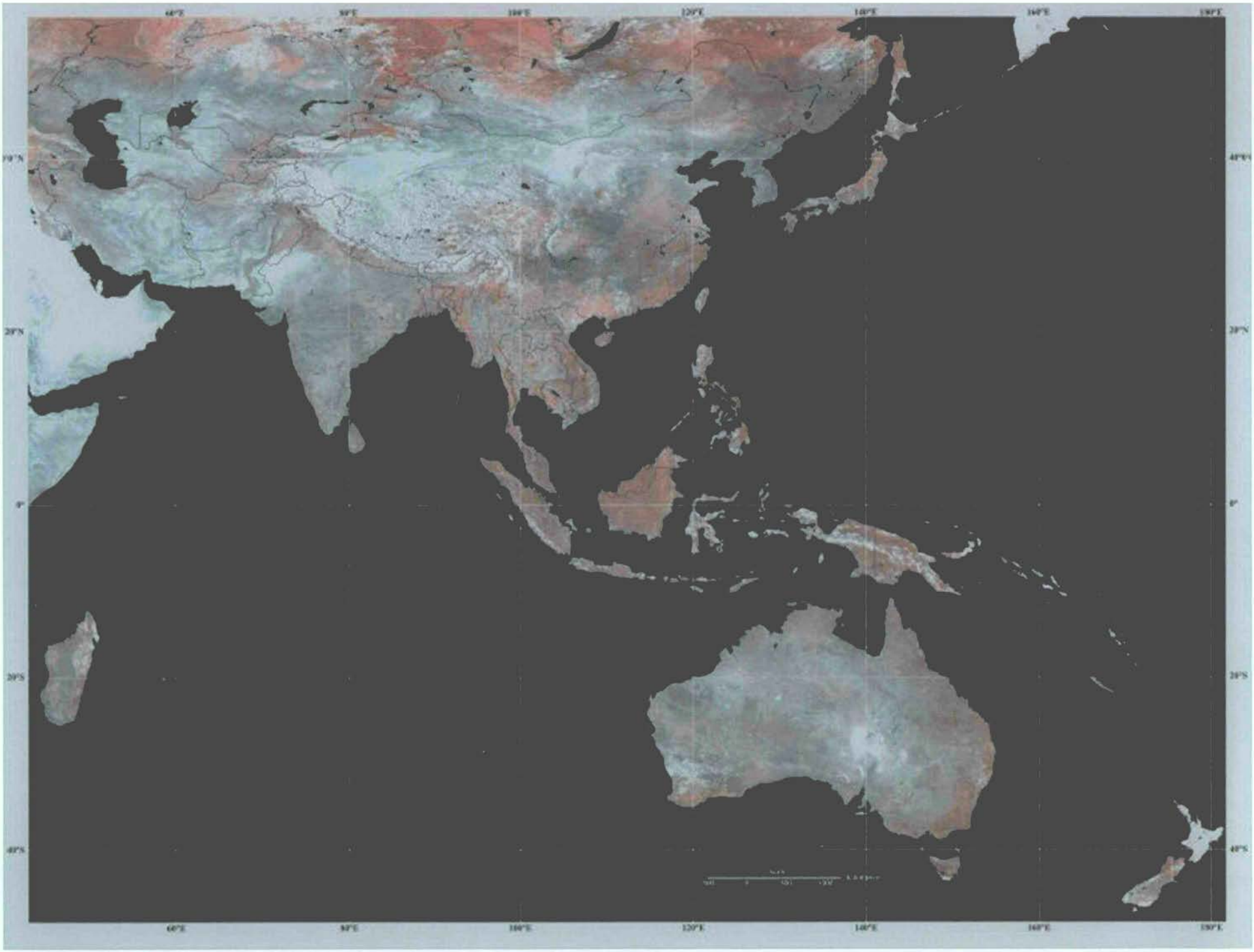
Transportation contributed the most to air pollution in the megacities of the region. In 1992, the estimated total number of registered vehicles in the region was over 130 million and growing at an annual rate of 3 percent to 4 percent. The introduction of unleaded fuels has reduced the average levels of lead pollution but the rate of decline is slower in the region than elsewhere. Ten of Asia's 11 megacities exceed WHO guidelines for particulate matter by a factor of at least three and 13 of the 15 dirtiest cities ranked by the level of particulate pollution are in Asia. The level of smoke and dust is generally twice the world average and more than five times the level in developed countries.

It is expected that the region's demand for primary energy will double every 12 years, much faster than the world average of every 28 years. Coal will remain the fuel of choice in the future because of its abundance and easy recoverability, and demand is projected to increase by 6.5 percent a year. At the current energy consumption rate, So_2 emissions from coal burning in Asia will more than triple within the next 12 years. This will result in a significant increase in both national and transboundary acid deposition problems. In addition, emissions from the transportation sector will further aggravate urban air pollution. Many ecosystems may be unable to absorb these increasing acid deposition and levels of pollution and the result may be irreversible ecosystem damage with far-reaching implications.

The measures proposed on mitigation and control of air pollution and green house gas (GHG) emissions included: a) framing or review appropriate policy, legislations, and strategies to integrate air pollution and climate change issues into national development plan and sectoral plan; b) ensure implementation of these policies and legislations on control of air pollution and GHG emission c) develop action plan on mitigation and control of air pollution and GHG emissions in urban cities; d) update national inventories of GHG sources and sinks in accordance with the guidelines formulated by the International Panel on Climate Change; e) develop institutional, technical and human capabilities at the national level to monitoring, reporting and control of air pollution and GHG emissions; f) establish monitoring mechanism for transboundary air pollution and acid rain at the subregional and regional level; g) promote public awareness and encourage the participation of all stakeholders in activities addressing air pollution and climate change issues; and h) promote subregional and regional cooperation on information dissemination, monitoring of transboundary air pollution, capacity building, and technology transfer.

CHAPTER 1

State of the Environment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Chapter 1
State of the Environment

1.1 INTRODUCTION

The Asia-Pacific region encompasses a very diverse group of countries in terms of population, geography, natural resource endowments, and economic development. The region includes the world's most populous countries, such as China and India; the most densely populated country and city-state, like Bangladesh and Hong Kong; and the small island states in the Pacific or a land-locked country like Bhutan with very small populations. In terms of economic variability, the region has some of the very rich countries in the world, such as Japan, South Korea, Taiwan and Singapore, and some of the poorest, such as Laos, Cambodia, Nepal and Bangladesh.

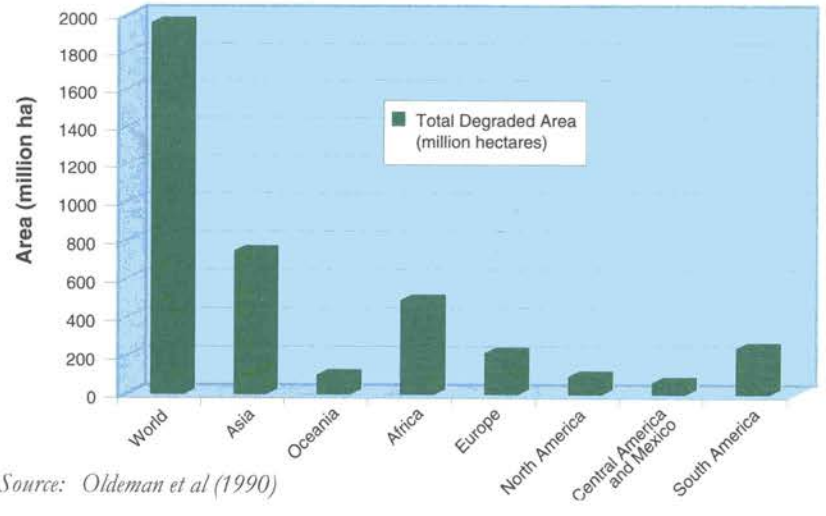
In the last hundred years, most of the countries of the region have undergone social, political and economical transformations. Colonialism, which dominated the large part of the region, declined in this period and finally exited. This was replaced with monarchical or other forms of political systems like democratic republics, economies, which were largely agrarian and integrated with the rest of the world only on the basis of exports of primary products and imports of manufactured goods and services, transited by and large to semi-industrial and industrial economies with varied exports and greater voluntary integration with global market. Agricultural activities intensified to increase cereals and non-cereals production for home consumption and export. A concomitant of these developments were the societal changes in many countries like increases in human and livestock population, increase in literacy and health standards in many sub-regions and a great degree of social mobility as traditional and occupational social and community groupings dissolved. Speeding urbanization was a natural follower of these developments. These developments left inevitable footprints on the state of the environment in the region.

1.2 LAND AND FOOD

1.2.1 Developments over the past 100 years

At the turn of the century most countries in the Asia-Pacific region were agriculturally based, practicing traditional, rural subsistence farming, including shifting cultivation and nomadic livestock grazing. As the population increased, particularly after the Second World War, the need for greater food production put increasing pressure on land resources. The area of cropland expanded from 210 million hectares in 1900 to 470 million hectares in 1994 (see Figure 1.3), largely at the expense of forests and woodlands (WRI, 1987 and FAO, 1994). In addition, agricultural yields were dramatically improved in the last 40 years, largely due to the green revolution, which led to the development of high-yielding crop varieties, irrigation systems and

Figure 1.1: Human-Induced Soil Degradation (1945 -1990)



Degradaed Area as % of Vegetated Land :

World	17.0
Asia	19.8
Oceania	13.1
Africa	22.1
Europe	23.1
North America	5.3
Central America and Mexico	24.8
South America	14.0

Source: Oldeman et al (1990)

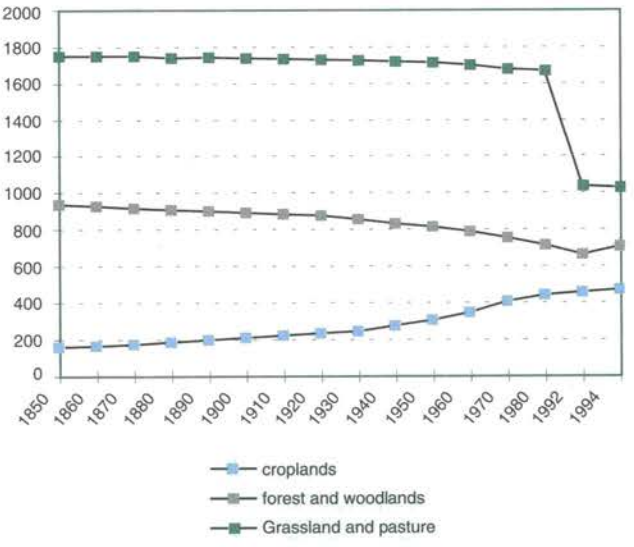
increased agrochemical inputs. The combination of extensive deforestation and unsustainable agriculture, together with inadequate soil conservation, cultivation of steep slopes, overgrazing and rapid urban and industrial growth has had a devastating impact on land resources. According to GLASOD, of the world's 1.9 billion hectares of land affected by soil degradation during the last 45 years, the largest area (around 550 million hectares) is in the Asia-Pacific region (Oldeman et al, 1990). This constitutes about 19 percent of the region's total vegetated land (see Figures 1.1 and 1.2).

In South Asia, the dominant thrust of colonial agrarian policy was to extend cultivation to increase revenue from agriculture, which resulted in extensive forest clearance (Gadgil and Guha, 1992). Unsustainable agriculture in countries like India, Bangladesh and Pakistan has resulted in increasing soil acidification and salinization (UNEP, 1993). In the arid and semi-arid areas of South Asia, desertification has been a major problem. As many as 63 million hectares of rainfed cropland and 16 million hectares of irrigated land have been lost to desertification (ESCAP, 1995), particularly in Afghanistan, Pakistan and India (UNEP, 1997).

In the Southeast Asian sub-region, land conversion was intensified during the 1960s-70s, due to increased commercial logging, the introduction of commercial crops and the improved production of staple foods (Kummer, 1993; Uhlig, 1984). In Malaysia, for example, arable land increased five-fold from 1900 to 1950 mainly to accommodate the growth of rubber and oil palm plantations (ADB, 1994b). As a result considerable forest areas were lost. In the Philippines, forestland dropped to less than 40 percent during 1960s while farmland increased to more than 25 percent (Kummer, 1993).

In East Asia, particularly in Japan and the Republic of Korea, rapid economic growth after World War II caused a dramatic increase in the conversion of natural and agricultural areas to urban and industrial sites. In China, the extent of arable land also decreased, by at least 35 million hectares between 1957-1990 - an area equal to all cropland in France, Germany, Denmark and the Netherlands combined (ESCAP, 1995) but in this case, largely due to land degradation. By 1996, the area of land affected by desertification accounted for 27.3 percent of China's total national territory (262.2 million hectares). At the same time, grain yield increased nearly 4 times between 1952 (about 1,300 kg/ha) and 1996 (about 4,600 kg/ha). Similarly grain production per capita increased from around 300 kg per year in 1952 to around 400 kg per year in 1996 (SEPA-China GEO-2 Input, 1997).

Figure 1.2: Trends in Land-use Changes in Asia and the Pacific (1850-1994)



Source: WRI (1987) and FAO (1994)

Land degradation is one of the most significant environmental problems facing Australia (OECD, 1998), and has been caused principally by the overuse of Australia's comparatively modest soil, vegetation and water resources for increased food, wood and fiber production, and coastal urbanization. Agriculture has been the largest land use in Australia with the greatest area supporting grazing of cattle and sheep. While 54 percent of Australia is extensively grazed by sheep and cattle, only about 6 percent of the country is arable, compared with about 20 percent of the USA. (Commonwealth of Australia, 1996). Overall, about 50 percent of land in Australia has been profoundly changed by complete clearing or thinning of native vegetation or other significant habitat modifications (e.g. overgrazing and changed fire regimes) since European settlement (Commonwealth of Australia, 1996; OECD, 1998). This Figure varies between different areas. For example, over 15 percent of Australia's rangelands, which cover over 75 percent of the continent, is sufficiently degraded through overgrazing by cattle, sheep and feral animals (e.g. rabbits and goats) to require de-stocking if it is to recover. About 75 percent of rainforests and 90 percent of temperate woodlands and mallee (open Eucalypt) woodlands have been cleared. In some wheat-growing regions, less than 10 percent of the native vegetation remains. Between 1974 and 1989, about 33 percent of the coastal bushland along the southeast Queensland coast was lost to urban development.

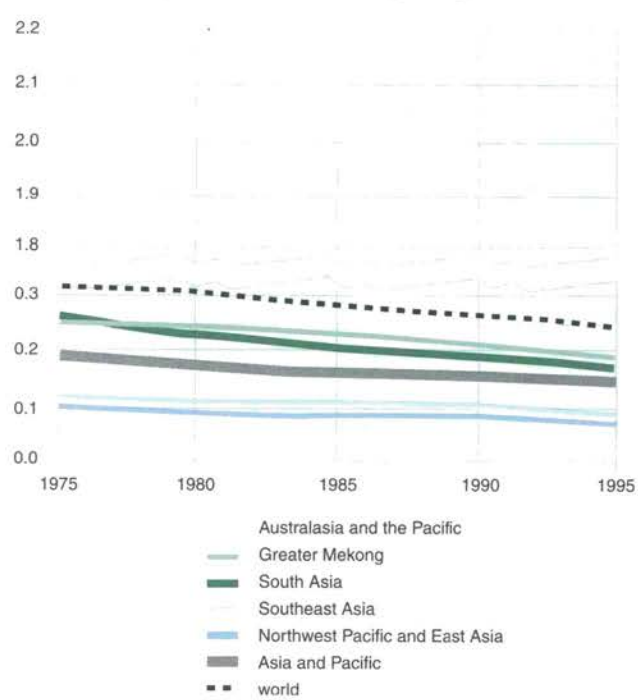
Forests and woodland communities cover 156.9 million hectares - about 20 percent of the continent (Commonwealth of Australia, 1997a). Although land clearing on the scale required to establish Australia's agricultural industries is no longer occurring (it peaked in the two decades after World War II), substantial areas are still being cleared (Australia GEO-2 Input, 1998). Since European settlement, Australia has lost an estimated 40 percent of its total forested area to clearing. An additional 40 percent of forests have been affected by logging at some stage (Commonwealth of Australia, 1996). In the 1950s and 1960s, long periods of high prices for many rural commodities and general national growth led to an expansion and intensification of farming. The area of land used for agriculture reached a peak of 500 million hectares in 1975 and has since been declining slowly (Australia SoE, 1996). In some wheat growing regions, less than 10 percent of native vegetation remains. For rainforests, medium, dense and tall forest types, about half of the original area since European settlement has been lost to agricultural clearing. A far higher proportion of low eucalypt forests, mallee and Acacia forests have been lost as these areas have been the focus of agricultural clearing. Urban expansion is rapidly occurring along the coastal areas of South East Queensland and Eastern Australia. For example, between 1974 and 1989, 33 percent of the coastal bushland along the South East Queensland was lost (Australia GEO-2 Input, 1998). Analysis of mean Australian wheat yields for each decade since 1870 suggests that early agricultural practices were unsustainable, but since about 1900 yields per unit area have steadily increased (about 400 kg/ha/year in 1910 to 1,400 kg/ha/year in 1990). During 1950 to 1989, overall farm output in Australia increased two and a half times, or about 2.5 percent per year, while real per-unit costs of production declined. The rate of increase in output per unit of land over the last three decades has been higher than for any other OECD country (Australia SoE, 1996).

In New Zealand, the main developments of the past century affecting soil quality and food production were; the conversion of large areas of forest and tussock land to pasture before 1920, which led to erosion increasing by 10-fold or more in some areas; the contamination of soil with heavy metals and hydrocarbons (from the 1920s on) and persistent organochlorines (from the 1950s to the 1970s); the development of aerial top-dressing in the 1940s and 1950s which allowed light airplanes to drop lime, fertilizers and pesticides on otherwise inaccessible hill country, improving its productivity and allowing higher stock numbers; the expansion of urban settlements onto wetlands and fertile farmland on the fringes of big towns and cities (at an average rate of 4 percent per year since the late 1960s); and the removal of agricultural subsidies in the 1980s, leading to a decline in sheep numbers and a reduction in grazing pressure on some of the more erosion-prone hill pastures.

1.2.2 Developments over the past 10 years

The Asia and Pacific region has much less arable land per capita than the world average, even though Australia has more than any other country in the world. Figure 1.3 shows the arable land per capita across the region. Population density is the highest in South Asia with an average of 186 persons per square kilometre (km2). In 1992, the region had only 0.3 hectare of agricultural land per person, compared to 1.6 hectares in the rest of the developing world and 1.4 hectares in OECD countries. In 1994, the region (excluding Oceania) had 0.18 hectares of cropland per capita compared to 0.79 hectares per capita in North America, 0.43 hectares per capita in Europe, and 0.27 hectares per capita in Africa (WRI/UNEP/UNDP/WB, 1998). In some lowland areas in the Greater Mekong subregion the population per hectare of cropland is among the highest in the world (World Resources Institute, 1994) and in Nepal, the population density of arable land is 590 persons per sq.km. In China per capita land resources are less than one third the world average and per capita cultivated area is now only 0.085 hectares (SEPA-China, 1998).

Figure 1.3: Arable land per capita

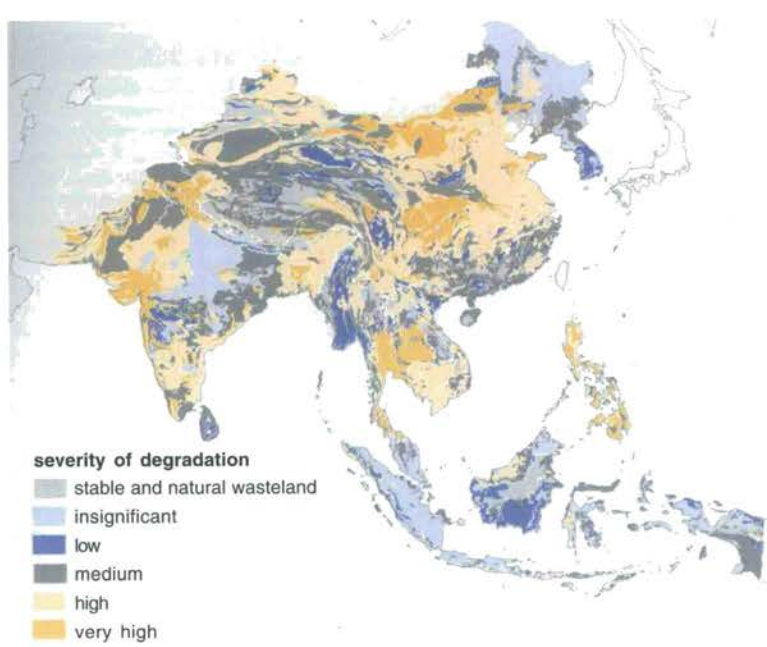


Source: GEO 2000

In the last decade, food production has continued to increase but has not matched the growth rate of the previous two decades and, with the exception of Southeast Asia, the region has not become a food surplus area. This is largely due to the unsustainable use of irrigated agriculture with excessive agrochemical inputs, which has degraded existing arable land areas and resulted in vast expanses of salinized, acidified and waterlogged soils with reduced fertility. In addition, prime agricultural land has been lost to urban, industrial and transport infrastructure, particularly in coastal areas. Attempts to compensate for this by expanding agricultural production into other areas, as occurred in previous decades, have been constrained by the decreasing availability of suitable land and widespread land degradation. Iran and India have already reached the limits of the potential of their agricultural land. The Asia-Pacific region as a whole is a net food importer: the net cost of imports amounted to US $7.3 billion in 1991. In 1996, the per capita cereal production in the region (excluding Oceania with 1.24 metric tonnes per capita) was 0.28 metric tonnes compared to 1.33 metric tonnes in North America, 0.54 metric tonnes in Europe, and 0.17 metric tonne in Africa (WRI/UNEP/UNDP/WB, 1998). Average consumption of cereal (the dominant food component in the region) remains at one-third of that in developed countries and average food availability, as a proportion of required daily intake, is low in many countries of the region. Food security is a very high priority in most countries of the region (ESCAP, 1995).

Land degradation, particularly soil erosion and desertification, has reduced the potential for land resources in several parts of South Asia (ADB, 1997). The more recent assessment in South and South East Asia found that more than 350 million hectares about 53 percent of all land in the ASSOD area are desertified and agricultural production is substantially reduced. Figure 1.4 presents the severity of soil degradation in South and South East Asia. In India, for instance, as much as 27 percent of the soil suffers from severe erosion (ADB, 1997) affecting an estimated 45 million tonnes of agricultural production annually (TERI, 1997). Water erosion is one of the principal causes of the removal of nutrient-rich topsoil in the region, particularly in the Himalayas. In India alone, 12.62 million hectares out of a total of 32.77 million hectares of agricultural land are affected by strong water erosion; similarly, in Iran, 45 percent of agricultural land is affected by light to moderate water erosion (FAO/UNDP/UNEP, 1994). Wind erosion is also extensive and severe, affecting about 59 million hectares in South Asia, particularly the dry-belt stretching from Central Iran to the Thar desert of Pakistan and India. Irrigated croplands of Pakistan are among the worst affected by salinity in the world where salt build-up in the soil is known to reduce crop yields by 30 percent (World Watch Institute, 1997).

Figure 1.4: Severity of soil degradation in South and Southeast Asia



Source: GEO 2000

Over the last two decades, agricultural land use in Southeast Asian countries has expanded only slightly from 16.8 percent of total land area in 1975 to 19.3 percent in 1992 (ADB, 1995) and the rate of growth in food production was much greater than elsewhere in Asia or the rest of the world (UNCTAD, 1994 and UN/ESCAP, 1995). In addition to intra-ASEAN trade, the major food crops are exported throughout the world and the region is also the major global exporter of rubber and palm oil. However, the introduction of the cash economy has induced some hill tribes to convert unsuitable upland areas to intensive commercial cropping, with disastrous effects for the watershed environment. Traditional rural people who rely on shifting cultivation (particularly in Malaysia where 30-40 percent of the rural population practice shifting agriculture) have been forced to move to marginal lands and, as a result of declining productivity, are having to adopt shorter fallow periods which is aggravating soil degradation. In Thailand, about 17 million hectares are moderately and highly vulnerable to soil erosion by water due to upland and highland agricultural expansion. In the Mekong basin, some of the most productive agricultural areas have been affected by saltwater intrusion and leaching, and the carrying capacity of these once fertile alluvial plains has reached its limit. Urbanization and industrial development, including the construction of dams and mining, have also contributed to land degradation.

In East Asia, urban and industrial expansions are increasingly encroaching on arable land. In Japan and Republic of Korea, for example, urban and industrial developments have occupied the flat coastal areas and farmers have increasingly cultivated forested hill slopes, which has contributed to a decline in agricultural production. Although food production continues to steadily increase in China, the potential for expansion is limited; over 70 percent of farmlands are in hilly areas and a quarter of the remaining grassland areas are severely degraded and salinized. Korea DPR continues to rehabilitate the area under irrigation because the irrigated areas are becoming less productive. The widespread flooding in 1995-96, which resulted in 7.5 percent of the total land area being covered in sand and debris, has contributed to the country's current famine. Japan and the Republic of Korea are now cutting back on the use of agrochemicals and China has placed 70 percent of farmlands under protection and has treated 20 percent of the desertified area. Other causes of land degradation in the subregion are mineral exploitation which has already degraded some 2 million hectares of land in China and continues to affect 40,000 hectares more each year; overgrazing in Mongolia by the nomadic livestock herds that occupy 75 percent of the total land area; and the creation of multi-tracks in the Gobi desert, after vehicles are driven on wide new strips alongside rural roads when old tracks deteriorate.

Until recently many people in Australia believed that the last major land clearing for agriculture occurred in 1970s and that relatively little had taken place since. However, a recent review undertaken for the National Greenhouse Gas Inventory suggests that annual rates of clearing over the last 10 years could be greater than 5000 sq. km. About six percent of the continent is now used for broadacre cropping (predominantly cereals), intensive grazing of sown pastures, intensive horticulture and field crops such as sugarcane and cotton (Australia SoE, 1996). In New Zealand, following the removal of subsidies for farmers, there has been a move away from inefficient subsidized activities (such as grazing sheep on marginal hill pasture) and into activities that have strong international markets (e.g. forestry, intensive dairy, deer and horticultural production). Self-help farmers' groups were set up in some areas to cope collectively with soil, water and pest control problems. A five-year rabbit control programme in the South Island high country became a test case for their efficacy in the early 1990s. Led and partly funded by the Ministry of Agriculture, but implemented through the self-help groups, it succeeded in reducing rabbit population. However, the search for a cheaper option led some high country farmers to illegally import the Rabbit Haemorrhagic Disease (RHD) virus into the country in 1997, in violation of the Biosecurity Act 1993. This virus is now widespread and has reduced rabbit population on many farms, allowing some vegetation recovery, but its long-term effectiveness is uncertain (New Zealand GEO-2 Input, 1992).

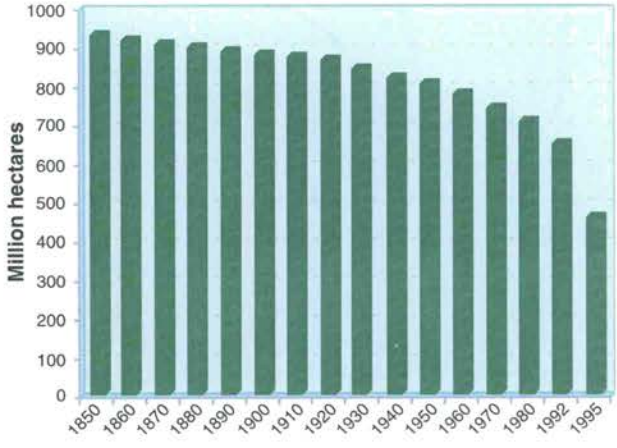
1.3 FORESTS

1.3.1 Developments over the past 100 years

In the last 100 years, primary forests in the Asia-Pacific region have been substantially depleted by a combination of causes including fuelwood harvesting, commercial logging, and land clearance for cultivation, infrastructure and settlement. Wars also had a substantial impact. Between 1850 and 1980, nearly 24 percent (224 million ha) of forests covering an area about the size of India were removed and, in the process, two thirds of wildlife habitats were destroyed (IUCN, 1986). As a consequence vast expanses of naturally fragile land, particularly watershed areas, have been exposed to soil erosion which have reduced the ability of the land to

absorb water, increased its susceptibility to flood, drought and landslides, and resulted in increased sediment load in rivers and the siltation of downstream areas. With the exception of China, rates of deforestation increased significantly from 1930 onwards (Figure 1.5) and are now estimated to be between 1-2 percent per year.

Figure 1.5. Trends in Forest and Woodlands Areas in Asia-Pacific 1850-1995



Source: WRI (1987), FAO (1994), WRI/UNEP/UNDP/WB (1998)

In South Asia, in the first half of the century, the dominant thrust of colonial agrarian policy was to clear primary forests in order to extend cultivation, particularly of commercial plantation crops. Forests were also heavily exploited for shipbuilding during the Napoleonic wars, for building infrastructure, particularly the railway network, and to meet the demands of World Wars I and II (Gadgil and Guha, 1992).

In Southeast Asia, at the turn of the century, low population density meant that traditional shifting agricultural practices had little impact on the abundant forest resources. Commercial logging was dominated by European countries through colonial rule or political influence. In the latter half of the 20th century, deforestation rates dramatically increased following the construction of multipurpose dams, the rapid expansion of irrigated agriculture and the introduction of the cash economy which induced hill tribes to convert forested upland areas to commercial crops. War in Indochina during the 1960s and early 1970s was extremely detrimental: about 2 million hectares of forest in Vietnam were destroyed through bombing and spraying of defoliant (World Conservation Monitoring Center, 1994) and the toxic after-effects of residual dioxin held back forest regeneration for several years, especially in mangrove areas. Similarly, there was substantial loss of forest cover in Northern Laos due to bombing during the war (World Bank, 1994). Shifting cultivation, spontaneous migration into forested areas and land clearance for food production were other major factors in deforestation in the Mekong basin in the past 50 years. Forest cover stands at approximately 36 percent on average for the Mekong sub-region (MRC, 1997). In Cambodia, there has been an average annual deforestation rate of 50,000 to 100,000 hectares from the early 1960s to the late 1980s. Since 1990, the rate of deforestation has accelerated rapidly. The current rate is estimated at 250,000 hectares annually, or 1.4 percent of the total land in Cambodia (MRC/UNEP, 1997b). In Vietnam, forest cover decreased from 43.3 percent in 1943 to 27.7 percent in 1991 (Cao, 1995). In Thailand, forest area covered over 50 percent of the country's total land area at the beginning of the 1st National Plan but has shrunk to less than 26 percent in 1996 (MoSTE/OEPP, Thailand, 1998).

In China, by the middle of the century, poor land management practices and plundering by imperialist countries had depleted forest cover from an estimated one- to two-thirds of all the land to just 7-8 percent of all land (SEPA-China). This contributed to a series of ecological disasters such as soil erosion and frequent flooding. Elsewhere in East Asia, logging and reforestation were more balanced until World War II, when vast expanses of Japan's forests were destroyed. In the former Korea (before separation), forest resources were excessively removed during the last years of Japanese colonial rule and were severely damaged by the Korean War (1950-1953) (OECD, 1997).

When Europeans settlers arrived in Australia in 1788, the land carried 69 million hectares of forests (almost 9 percent of Australia). Between 1788-1995, about 43 percent of forests, nearly 90 percent of temperate woodlands and mallee, and about 75 percent of rainforests have been cleared with half of this being converted for agriculture. In Australia, proportionately little of the different major forest and woodland types are currently protected under available IUCN categories (ranging from strict nature reserve to managed resource protected area). Most notably, only 22.5 percent of rainforests and about 14 percent of Eucalyptus-dominated forests currently falls within one or more of these categories (Commonwealth of Australia, 1997a). Furthermore, most conservation reserves in Australia occur in areas of low agricultural suitability, highlighting a shortcoming of Australia's reserve system (Commonwealth of Australia, 1996).

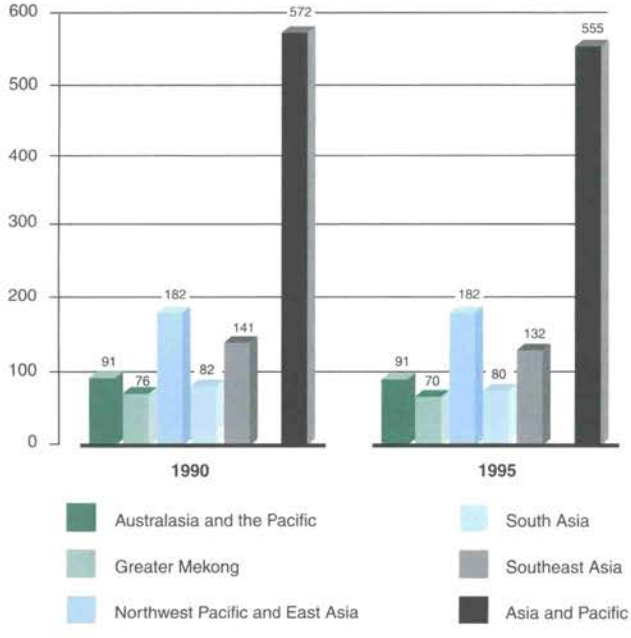
In New Zealand, the main developments of this century were: the reduction of 9.5 million hectares of indigenous forest to 6.2 million hectares; the

establishment of the NZ Forest Service in 1919 with the dual mission of creating a sustainable timber supply by replacing slow-growing native forest with fast-growing radiata pine from California (this led to massive planting programmes that established half of today's exotic forests and set up the economic and technical base for private companies to continue with the planting in recent decades) and protecting four to five million hectares of steepland forest for erosion and flood control (these protection forests form the bulk of today's remaining indigenous forest); the rise of a large forest conservation movement in the 1970s, opposing further logging of native forest; and the decline in sheep numbers from the mid-1980s, which allowed indigenous seedlings and exotic forest plantings to become established in some former pasture lands.

1.3.2 Developments over the past 10 years

The annual deforestation rate for tropical forests almost doubled between 1976 and 1990, increasing from 2 million hectares (1976-81) to 3.9 million hectares (1981-90) (FAO, 1993a). This represented the highest annual rate of deforestation (1.2 percent) among the tropical regions of the world during 1981-90 and accounted for one third of net (3.9 out of 15.4 million hectares) deforestation worldwide. However, the estimated rate for 1990-95 was slightly lower at 1.1 percent (FAO, 1997a). Five countries (China, Indonesia, Malaysia, Myanmar and the Philippines) account for 80 percent of deforestation in Asia (ADB, 1997). During 1990-95,the region's forests were reduced by 17 million hectares. Deforestation was fastest in the Mekong (1.6 percent per year) and in South east Asia.

Figure 1.6: Forests extent, 1990 and 1995



Source: GEO 2000

Figure 1.6 shows the forest extents between 1990 and 1995 across subregions in Asia.

The major direct causes of forest loss in the region were excessive cutting for timber and clearing for agriculture (FAO, 1997a; ESCAP, 1995). Fuelwood harvesting, shifting cultivation, irrigation and hydroelectric power development, mining and the development of urban and industrial infrastructure, and diseases also contributed significantly to deforestation rates. In addition, the use of fire to clear forest for both shifting agriculture and commercial cultivation has increased dramatically in recent years. More than 1 million hectares of Indonesia's national forests have been and continue to be destroyed by exceptionally large-scale forest fires that have burned almost continuously since September 1997 (EEPSEA and WWF 1998). The 566 million hectares of forests that remain in the Asia-Pacific region seem incapable of satisfying the growing needs of the increasing population and domestic wood shortages are beginning to appear. While Asia-Pacific continues to suffer the fastest rate of conversion of natural forests in the world, the region can take pride in its record of forest plantation establishment. The region stands as the leading region for forest plantations among the developing countries of the world. Among the top 15 developing countries for forest plantation establishment, nine are located in the Asia-Pacific region - China, Bangladesh, Indonesia, Republic of Korea, Myanmar, Philippines, Thailand and Vietnam (FAO, 1997a; Swaminathan and Joseph, 1998).

South Asia has the region's lowest per capita forest cover at 0.08 hectare (UNEP, 1997). During 1981-90, Bangladesh and Pakistan experienced the sub-region's fastest rates of deforestation (FAO, 1993a). Throughout the sub-region, demand for fuelwood is rapidly expanding due to high population growth rates and inadequate development of alternative energy sources (Sharma, 1996). In Nepal, over 75 percent of the population depends on fuelwood for its energy requirements (HMG Nepal, 1995). Commercial logging, industrialization, agricultural expansion and trade in forestry products have further depleted forest resources and contributed to the emergence of domestic wood shortages.

Southeast Asia now has the highest deforestation rate in the region. During the 1980s, forested areas decreased by nearly 15 percent, at an average of 1.6 percent per year - more than double the rate of forest depletion elsewhere in the world (WRI, 1996). Despite this, forest cover in Southeast Asia as a proportion of total land remained one of the highest in the world at

about 52 percent of the total land area, compared to 47 percent in South America and 20 percent for Asia as a whole (WRI, 1994). However, by 1990, average per capita forest cover in Southeast Asia was only 0.46 hectare compared to 0.64 hectares per capita on a global basis and 0.19 hectares per capita for the region as a whole (FAO, 1997c). Commercial logging contributed significantly to deforestation rates; around 80 million Cubic Metre of roundwood are cut as commercial timber annually, especially in Malaysia and Indonesia (ASEAN, 1997). With rapid economic growth in recent decades, many forests in the Mekong basin countries have already been logged for commercial species and larger logs and are now of critically poor quality, with low levels of biomass density. For example, only about 10 percent of the remaining forests of Lao PDR are commercially valuable (MRC/UNEP, 1997b). In Vietnam, it is estimated that rich and medium grade forests account for only 9.3 percent and 22.8 percent of all forest areas, respectively (MoSTE/Vietnam, 1994). To protect heavily denuded areas, several countries have introduced sustainable forest and agricultural management policies and increased the extent of protected areas. Prior to the logging ban in 1988, forest depletion in Thailand averaged more than 480,000 hectares per year (MoSTE 1997). But the logging ban had not been fully effective in halting forest destruction since forests were still being depleted at an average rate of about 100,000 hectares per year during the period 1993-1995 (MoSTE/OEPP, Thailand, 1998).

In many East Asian countries, imports of forest products increased over the last decade and today most timber is imported from abroad. For example, in Japan, wood self-sufficiency declined from about 73 percent in 1964 to 25 percent in 1992. Deforestation in Japan is mainly caused by development of leisure areas (ski resorts, golf courses) with accompanying road construction. In Korea DPR, illegal and unmonitored logging still remains a significant cause of deforestation while in the Republic of Korea deforested areas increased gradually from 1984 to 1994 despite government programmes that afforested more than one million hectares (Republic of Korea, 1998). In Mongolia, forest and woodland areas declined by 9.4 percent between 1984 and 1994, and more than 3 million hectares of forests burned in 1996 (FAO, 1997a). China has limited forest resources with present forest covering just 14 percent of land area (only 3 percent of the total forest area of the world) (SEPA, 1998). Commercial logging, land-clearance for cultivation, unreasonable forest wood pricing and lack of efficient forest management have resulted in many forest areas being excessively cut leading to degradation of forest ecological functions. However, government afforestation campaigns increased forest cover from 12 percent in the 1980s to 13.92 percent (34.25 million hectares) in 1996 (SEPA 1996).

In New Zealand, the main developments of this decade were: the Forests Amendment Act 1993, which banned the use of native logs for timber except where they are from a certified sustainable management forest; and the New Zealand Forest Accord 1992 between environmentalists and major forestry companies, agreeing that future exotic forest planting would not be at the expense of indigenous forest or significant wildlife habitat. The Accord does not bind all forest owners, but has significantly modified the behaviour of the larger companies. Of the surviving indigenous forests, 4.9 million hectares are Crown-owned and 1.3 million hectares are privately owned. Most of the Crown forests are on fully protected conservation land, except for 150,000 hectares set aside for timber production on the West Coast. The biggest threat to the remaining forests comes from tree and seedling destruction by possums, goats and deer. This poses a serious risk to biodiversity on some 1.8 million hectares land of the Department of Conservation. Today, native forest seedlings are regenerating on some previously grazed steepland slopes. In addition, exotic forests, which covered 1.6 million hectares in 1996, have been expanding at a rate of 70,000 hectares per year through new planting, and are predicted to keep expanding at about 50,000 hectares per year in the first decade of the new millennium (Ministry for Environment, New Zealand, 1998).

1.4 BIODIVERSITY

1.4.1 Developments over the past 100 years

The Asia-Pacific region encompasses parts of three of the world's eight biogeographic divisions, namely the Palaearctic, Indo-Malayan and Oceanian realms. The region also includes the world's highest mountain system (Himalayas), the second largest rainforest complex and more than half the world's coral reefs. Of the seventeen identified 'mega-diverse' countries in the world which account for more than two-thirds of the earths entire biological resources, seven are in the region, namely Australia, China, India, Indonesia, Malaysia, Philippines, and Papua New Guinea. The region has a wealth of over 165,000 vascular plant species. Approximately 120 million hectares of wetlands are recognized internationally of which 85 percent are in eight Asian countries, namely Bangladesh, Cambodia, China, India, Indonesia, Myanmar, Papua New Guinea, and Viet Nam.

In the last half of the century, the rich biological resources of the Asia-Pacific region have been increasingly exploited both for international trade and to sustain the region's growing population. The direct harvesting and export of natural products, particularly timber and fish, from Asia-Pacific's tropical countries to industrialised and developed countries throughout the world has significantly contributed to development within the region and plays a major role in the economies of almost all nations (with the exception of Singapore and Brunei Darussalam). At the same time, agricultural production for commercial crops, as well as shifting cultivation and livestock herding, has been increased by expanding arable land into primary forests, wetlands and grasslands and by replacing traditional native crops with high-yielding exotic species. The effect of these developments on the region's biodiversity has been severe. About two-thirds of Asian wildlife habitats have already been destroyed and an estimated 70 percent of the major vegetation types in the Indo-Malayan realm (the region covering South Asia, Mekong, and Southeast Asia) have been lost, with a possible associated loss of up to 15 percent of terrestrial species. Dry and moist forests have suffered 73 percent and 69 percent losses, respectively, and wetlands, marsh and mangroves have been reduced in extent by 55 percent (Braatz, 1992; MacKinnon, 1994). The "hot spots" (where the disappearance of already-threatened moist tropical forest would cause the greatest losses of biodiversity) in Asia-Pacific include the remaining forests in the Philippines, peninsular Malaysia, northwestern Borneo (Brunei, Sabah and Sarawak), the eastern Himalayas (Nepal, Bhutan, northern India and a part of Yunnan Province in China), the Western Ghats in India, southeastern Sri Lanka, and New Caledonia (ESCAP, 1995). Mangrove destruction for aquaculture has often triggered coastal ecosystem degradation. One example of this is the Chakaria Sundarbans in eastern Bangladesh, which have been almost completely cleared for aquaculture (ESCAP, 1995). Overall habitat losses have been most acute in the Indian sub-continent, China, Vietnam and Thailand (Braatz, 1992). The rise of modern agriculture with its tendency to raise monoculture by introducing exotic, high-yielding crops at the expense of local and wild varieties has resulted in the loss of genetic diversity. In Indonesia, for example, around 1,500 varieties of rice disappeared during the period 1975-90 and similar trends can be observed throughout the region (WRI/UNEP/IUCN, 1992).

Coastal biological resources have been depleted by excessive and unsustainable commercial fishing activities, including poison and blast fishing. At the same time, pollution from shipping, in particular oil and in some areas the discharge of toxic wastes, has adversely affected the marine environment (ESCAP, 1990 and 1995). Coastal ecosystems, particularly coral reefs and associated fish life, have been degraded by the combined effects of agricultural runoff, urban sewage, industrial pollution, and siltation from erosion due to various causes. Mangrove forest systems, which serve as a spawning ground for numerous aquatic species, have been increasingly replaced with aquaculture production. In addition, urbanization, industrialization, pollution, mining, tourism, illegal trade in endangered species and the lack of proper management practices have taken their toll on the region's biological diversity.

Because of lack of data it is not known how many species, particularly endemic species, have already become extinct due to human activities. Even in those countries where descriptions of flora and fauna exist there is little information concerning distribution and population (Dearden, 1996). In many cases, where literature does exist, the Figures have often not been revised since the information was collected (ESCAP, 1995). However, it is probably fair to assume that extinction rates are closely linked to rates of habitat loss and fragmentation due to land use change and modifications to the marine environment as a result of human activities.

In South Asia, the major concern that has emerged over the last century has been the loss of terrestrial biodiversity, particularly in the Indian sub-continent where the already existent high pressure on Indian grasslands has been compounded by rapid growth in human and livestock populations (WCMC, 1992). In addition, the drive for increased agricultural production has resulted in the loss of genetic diversity, particularly in varieties of rice.

The Southeast Asian region is the center of diversity of wild and domestic cereals and fruit species (ASEAN 1997). At the turn of the century, the wide variety of forest products, including wood, wildlife, honey, herbs etc, were the main sources of food and income for the region's indigenous people. In the second half of the century, unsustainable rates of deforestation led to the depletion of these resources. Overall biological destruction was comparatively less severe in the Mekong basin which is ecologically significant for its thousands of endemic species, particularly along inaccessible national borders that are remote from populated areas and transportation links. Southeast Asia has also experienced among the highest rates of destruction of coral reef and mangrove habitats in the world and this, together with coastal pollution, has greatly damaged marine biodiversity. Although some of

Singapore's coral reefs and seagrass beds have been degraded, nevertheless, coral diversity of the remaining areas is good (Chou, Goh and Lam, 1998). Some of the sites with good mangrove stands have been designated as nature areas and the health of these areas are being monitored periodically (MoE, Singapore, 1998). Indonesia is among the five top countries of the world with over 30,000 plant diversity. More than half of Thailand's mangrove forests (some 208,218 hectares) disappeared between 1961-93 (GESAMP, 1993). Conversion of mangrove forest to shrimp mariculture and the use of unsustainable fishing practices, such as blast fishing, are widespread. In addition, oil pollution and maritime activities have further depleted fish stocks (Government of Malaysia, 1992).

China is ranked third in the world for biodiversity with over 30 thousand species of advanced plants and 6,374 kinds of vertebrates, representing 10 percent and 14 percent of the world total, respectively. In Japan, industrialization from the mid-1800s, modification of rivers and coastal areas, water pollution and excessive hunting have resulted in loss of forests and grasslands and the extinction of some large mammals and other wildlife species. Extensive areas of mangrove forests and some 90 percent of coral reef habitat in the south of Japan were destroyed largely through land reclamation projects (EA, 1997; Research Group on Coral Reef Regions in Japan, 1990). Land reclamation and other coastal developments were also responsible for the destruction of wildlife habitat and some fine natural coastlines in the Republic of Korea (MoE, Korea Rep., 1994).

Habitat modification - especially the clearing of native vegetation for agriculture, urban development (including the depletion of coastal habitats), forestry and introduction of exotic species - has been and remains the most significant cause of loss of biodiversity in Australia and New Zealand. Australia has the world's worst recent record of mammal extinction. In the past 200 years, 10 of 144 species of marsupials and 8 of 53 species of native rodents have been lost (Australia GEO-2 Input, 1998). More than half of the land clearing has occurred in the last 50 years, and is still proceeding at a high rate in Australia. Exotic organisms - including species whose range and abundance have changed because of human activities - have exerted pressure on biodiversity in Australia. For instance, the most damaging exotic species, selected from a list of over one thousand species, include rabbits (of which there are about 200 million), foxes (5 million), cats (12 million), domestic and feral goats, Buffel grass, Rubber vine, Para grass and Giant Sensitive plant, Siam Weed, and the fungus. In addition, Australia carries a large load of domesticated animals, notably 26 million cattle and 126 million sheep. Other pressures on Australia's biodiversity include the harvesting of native species, pollution from industrial sites and urban areas, fertilizers and other agricultural chemicals, and changes in fire management regimes. For example, long-line fishing of southern bluefin tuna has threatened the survival of the wandering albatross in southern Pacific seas over the past two decades. But kangaroos have increased significantly in abundance in some areas due to improvements in pasture production and provision of groundwater bores.

Most of the damage to New Zealand's biodiversity was done prior to this century - first by Maori deforestation and over-hunting and then by European deforestation and introduction of pest species. Extinction in this century have been few but the effects of earlier habitat destruction and encroachment by pests have pushed many more indigenous species onto the threatened list. Today, nearly 1,000 of the known animals, plants and fungi have been identified as threatened (some 800 species and 200 subspecies). They include: more than 200 fungi (5 percent of known species); nearly 200 vascular plants (10 percent); 85 non-vascular plants (8 percent); 150 vertebrate animals (58 percent); and at least 285 invertebrate animals (1-2 percent). One of the worst affected groups is New Zealand's endemic land and freshwater birds, three-quarters of which (37 out of 50 species) are now threatened (New Zealand GEO-2 Input, 1998).

1.4.2 Developments over the past 10 years

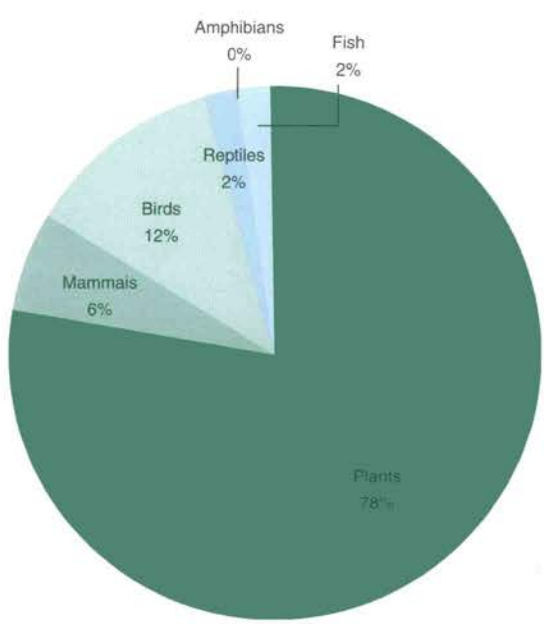
Despite the increasingly unsustainable exploitation of natural resources, the Asia-Pacific region is still, as yet, one of the world's richest reserves of both terrestrial and marine biological resources. However, in the last decade, demand on biological resources sharply increased due to rapid economic and population growth. This has resulted in accelerated rates of land-use change, the further fragmentation and destruction of primary forests, wetlands and grasslands, which in turn has affected predator-prey equilibrium and species diversity.

The true extent of habitat change and species loss over the last decade has yet to be fully quantified. However, as a result of the rapid, largely uncontrolled and increasing consumption of natural resources, many countries have a number of plants and animals that are significantly threatened (Figure 1.7). To date, a few countries have designated more than 15 percent of their land as protected areas but lack of resources, weak policy enforcement, weak institutional capacity and poor interagency cooperation within the region are still

limiting factors. For instance, Maldives has designated more than 15 percent of its land and sea as protected areas. Most of these protected areas are coral reefs (Government of Maldives, 1998).

In South Asia, the main causes of terrestrial biodiversity loss over the last decade were international trade (particularly in timber), the introduction of non-native species, improper use of agro-chemicals, excessive hunting and poaching, and illegal trade in endangered species. In particular, falcons are smuggled to the Middle East from Pakistan, lizards and snakes are killed for their skins, and crocodile hunting is still a popular sport and recreational activity (Government of Pakistan, 1994). In the Sunderbans, shifting cultivation, the clear-felling system and reduced inflow of fresh water during the dry season have all contributed to species loss (Government of Bangladesh, 1994). Marine and coastal tourism is also threatening the region's marine biodiversity (Government of Maldives, 1994), particularly coral reefs. The Asian Wetland Bureau has estimated that 15 percent of all wetland habitats in South Asia are

Figure 1.7: Threatened Plants and Vertebrates in the Asia and the Pacific



Source: WCMC 1992

afforded some legal protection, but only 10 percent are totally protected. The degree of protection in South Asia is greater than in Southeast Asia and East Asia (Samar Singh, 1994).

In Southeast Asia, the rates of removal of primary forests are among the highest in the world. This together with expansion of commercial agricultural production and subsistence farming into natural ecosystems has contributed to increasing habitat fragmentation and loss and threatens to deplete flora and fauna (MRC/UNEP, 1997b). As early as the mid-1980s, an IUCN-UNEP study (using vegetation maps and satellite imagery) found that over two-thirds of the original wildlife habitat in the Indo-Malayan bio-geographical region has been lost (ASEAN, 1997). The costs of this degradation are readily apparent to large numbers of rural poor who rely on wildlife as a source of food, income and medicine. However, traditional practices are also contributing to biodiversity depletion. In Lao PDR and Vietnam, for example, wildlife meat is considered a delicacy and a wide range of species (reptiles, amphibians, birds and mammals) is hunted for this purpose (MRC 1997). Throughout the sub-region, the rapid change in agricultural practices towards modern varieties of rice has significantly reduced the use of wild and local varieties of seeds.

In East Asia, 156 of the 640 species listed for protection in the index compiled under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are found in China and around 15-20 percent of the country's fauna and flora species are endangered. In Mongolia, 17 species of mammals, 18 species of birds and 80 species of plants have already been classified as endangered (listed as Red Data species). Poaching and the illegal harvesting and trade of medicinal plants and animals have been increasing both in the Republic of Korea and especially in Mongolia from where they are exported for sale in the lucrative black markets of their Pacific neighbors (JEC, 1994) (Republic of Korea).

Every ecosystem in and around Australia, with the possible exception of the deep ocean, has been modified in some way, with varying impacts on biodiversity. However, limited baseline information makes assessment difficult. For the land animals and plants, about which we know enough to assess their current state, the trends are disturbing. Across Australia, some 5 percent of higher plants, 23 percent of mammals, 9 percent of birds, 7 percent of reptiles, 16 percent of amphibians and 9 percent of fresh-water fish are extinct, endangered or vulnerable. In contrast to species, ecosystems in Australia have no nationally agreed classification system; and vegetation assemblages and marine habitat types must be used as surrogates to draw broad continental generalizations. The changes to some of Australia's major ecosystems for the period 1788 to 1995 may be summarized as follows (Commonwealth of Australia, 1996):

- Seagrass beds in temperate areas have declined significantly.
- Overall, about 40 percent of all forests have been cleared.
- More than 60 percent of coastal wetlands in southern and eastern Australia have been lost.
- Nearly 90 percent of temperate woodlands and mallee have been cleared.
- More than 99 percent of temperate lowland grasslands in southeastern Australia have been lost.
- About 75 percent of rainforests have been cleared.

In New Zealand, there have been more additions to the lists of threatened species. Another recent development is the destruction of seamount ecosystems by fishing trawlers seeking deep-water fish, such as orange roughy. Anecdotal evidence from trawler crews and fishery scientists suggests that large numbers of corals and other marine invertebrates are killed when the trawlers first move onto a seamount and then populations decline markedly as fishing progresses (Jones, 1992; Probert, 1996).

1.5 WATER

1.5.1 Developments over the past 100 years

Freshwater withdrawal from rivers, lakes, reservoirs, underground aquifers and other sources increased more in Asia during the last century than in other parts of the world, from 600 cu kms in 1900 to approximately 5,000 cu kms by the mid-1980s (da Cunah, 1989). The largest increases in demand were in agriculture, mainly for irrigation, followed by industry. At the same time, contamination by pollutants degraded water quality seriously, thus reducing the availability of clean water supply. The rapid increase in freshwater demand led to a significant increase in the number of dams and reservoirs constructed in the region during the 20th century. For example, the number of large dams increased from 1,562 in 1950 to 22,389 in 1986 (ICOLD, 1984 and 1989). However, the annual per capita availability of freshwater in developing countries decreased from 10,000 Cubic Metre per capita in 1950 to approximately 4,000 Cubic Metre per capita in the 1990s (Ayibotele and Falkenmank, 1992).

As the population continue to increase, South Asian countries have gradually shifted towards water stress and scarcity. Agriculture has accounted for the bulk of water withdrawals, particularly in Afghanistan at 99 percent (UNEP 1997). As a result of the green revolution and increased irrigation, since the mid-1960s groundwater depletion has emerged as a problem in many parts of India, Bangladesh and Sri Lanka. For example, in India, the number of agricultural pumps doubled from 4.3 million in 1980-81 to 9.1 million in 1991-92, and after a decade of pumping the water table dropped considerably (ESCAP, 1995). Another problem that has emerged in the region is groundwater contamination. An example is the arsenic contamination of groundwater in Bangladesh and some adjacent parts of India (Box 1.1).

Box 1.1: Arsenic Pollution in Bangladesh

In Bangladesh, almost 97 percent of the population has access to groundwater from more than 4 million tubewells. However, many of these tubewells have been found to contain high concentrations of arsenic. About 20,000 tubewells have so far been tested and 19 percent have been found to contain unacceptable levels of arsenic. Bangladesh has set the acceptable limit of arsenic concentration in water at 0.05 milligram per liter. To date 2,200 cases of arsenicosis patients have been identified. The cause of arsenic contamination in groundwater is not yet known. However, natural geological changes are presumed to be the primary reason for arsenic contamination. The basis for such belief lies with the studies conducted in West Bengal, India having similar alluvial deposits.

Source: MoHFW, Bangladesh, 1998

The climate of Southeast Asia, which is predominantly wet equatorial, is characterized by a substantial rainfall supply of about 3,800 cu kms annually, about two-thirds of which is accounted for by Indonesia (ASEAN, 1997). Annual internal renewable water resources per unit of land area range from about 2,200 to 14,000 Cubic Metre per hectare throughout most of the Southeast Asian countries (ASEAN, 1997). By the mid-1970s, concerns over the sustainability of water supply and protection of water quality had become important issues. Deforestation in some important watershed areas had reduced the water level in rivers, especially in dry seasons. At the same time, the demand for water intensified to meet the increasing needs of irrigated agriculture, hydropower generation, and other domestic and industrial activities. The problem of water shortage in the region is compounded by the serious sedimentation of rivers. For instance, the level of total suspended solids (TSS) of the Mekong River reaches an average of approximately 294 mg per liter compared to the Ganges River at 1,130 mg per liter (MRC/UNEP, 1997b).

In East Asia, water pollution from industry was a primary factor threatening both water quality and quantity, particularly in the 1970s and 1980s. Along with economic and population growth, water consumption increased particularly in Japan. Total water consumption in Japan between 1975 and 1994 increased by 4 percent (Water Resources Department of Japan, 1997). In China, lake shrinkage and contraction of wetlands significantly reduced river runoff.' In addition, the climate became warmer and drier in the north, affecting natural water bodies. Some areas experienced frequent droughts in the 60s and 70s. In Beijing, the daily demand for water increased almost 100-fold between 1950 and 1980 (WRI, 1991).

Of all continents, Australia has the least river water, the lowest percentage of rainfall as run-off, and the smallest area of permanent wetlands. Much of the country is liable to experience severe drought that, in eastern Australia, is caused by the El Nino-Southern Oscillation (ENSO). After World War II, in an attempt to ensure a reliable water supply for domestic and irrigation purposes and to drought-proof the country, Australia initiated a massive nationwide programme of dam building. The environmental stress caused by this over-allocation of water for human use and consumption is greatest along the eastern seaboard and in the Murray-Darling Basin. Some 80 percent of the divertible or accessible water in the Murray-Darling Basin has now been developed for human use. Elsewhere, the environmental stress is far less severe (and absent in undeveloped areas). Large areas of wetlands have also been destroyed or seriously disturbed, and the banks of most rivers have been damaged since European settlement. Irrigation uses the most water, accounting for 70 percent of the developed resource. A serious environmental consequence of both irrigation and land clearing of deep-rooted trees for shallow-cropped annual crops is salinization - the result of rising water tables that bring dissolved salts to surface soils and waters. In some parts of the Murray-Darling Basin, the water table is rising by as much as 0.5 metre a year. In dryland catchments in southeast Australia, the water table has risen by up to 30 metres since 1880s. As a consequence, salt loads and concentrations have risen in many rivers in southeast and southwest Australia (Commonwealth of Australia, 1996). Increasing salinity and turbidity in some aquatic environments have contributed to the elimination of sensitive species, resulting in altered ecological communities (Australia SoE, 1996). Australia is also effectively mining its groundwater, with reserves being used much faster than they are replenished. Groundwater is often very old, with some bores tapping water that entered the ground 1-2 million years ago (Commonwealth of Australia, 1996).

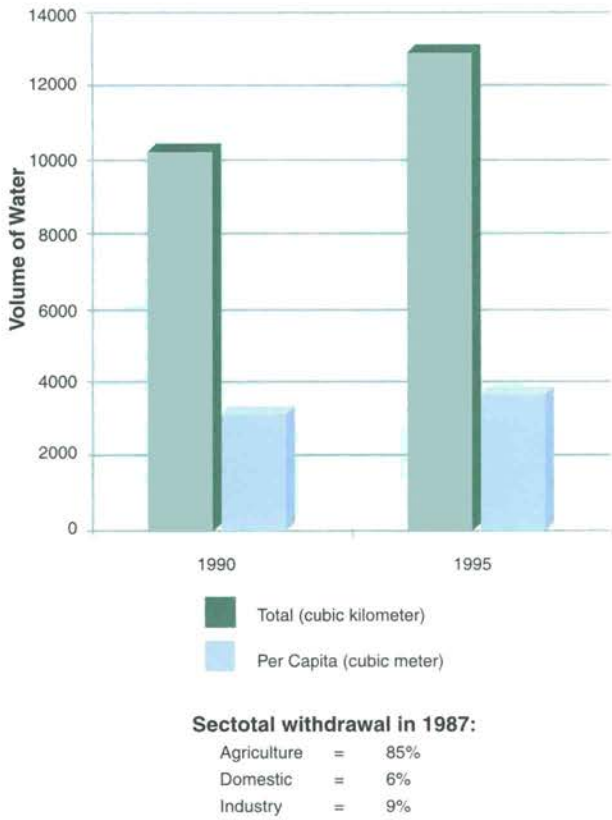
The impacts of water shortage have become more pronounced in some parts of New Zealand as demand for water has increased. Between 1980 and 1993, for example, water abstraction increased by an estimated 67 percent. The main demand is from pasture irrigation (1,100 million Cubic Metre per year) and livestock consumption (350 Mm3/yr), both of which have increased through the century. Large government-supported irrigation schemes began in 1910 and by the 1980s covered over 300,000 hectares. Direct or point source pollution increased until the 1960s but declined after that as stricter regulations and new treatment methods were developed. Daily pollution from sewage increased between 1900 and 1950 from about 60 tonnes of BOD to over 100 tonnes. Between 1950 and 1996, however, the number of sewage treatment plants grew from 5 to 258, bringing the total BOD back down to less than 60 tonnes. Other developments in the past century include the draining of 85 percent of New Zealand's wetlands, the removal of riparian vegetation from stream banks, flood control channeling, and hydro development. These have changed the natural character of many rivers and estuaries (New Zealand GEO-2 Input, 1998).

1.5.2 Developments over the past 10 years

During the last decade, the region's water resources have been increasingly strained by rapid population, urban, agricultural and industrial growth. Most developing countries in the region have experienced growing water scarcity, deteriorating water quality, and sectoral conflicts in water allocation. In many parts of the region, misuse and over-exploitation of water resources have resulted in the depletion of aquifers, falling water tables, shrinking inland lakes and diminished stream flows, even to ecologically unsafe levels. In Asia, water withdrawals for human consumption and agriculture in the 1980s accounted for more than 90 percent of total withdrawals, of which 86 percent were used for agriculture, mainly irrigation (WRI, 1992). Figure 1.8 shows the state of renewable water resources and water withdrawal during the 1980s and 1990s. Fresh water resources vary greatly with a regional average of about 4200 Cubic Metres per capita per year- a little more than half of the world average of 7000 Cubic Meters per capita per year, as shown in Figure 1.9.

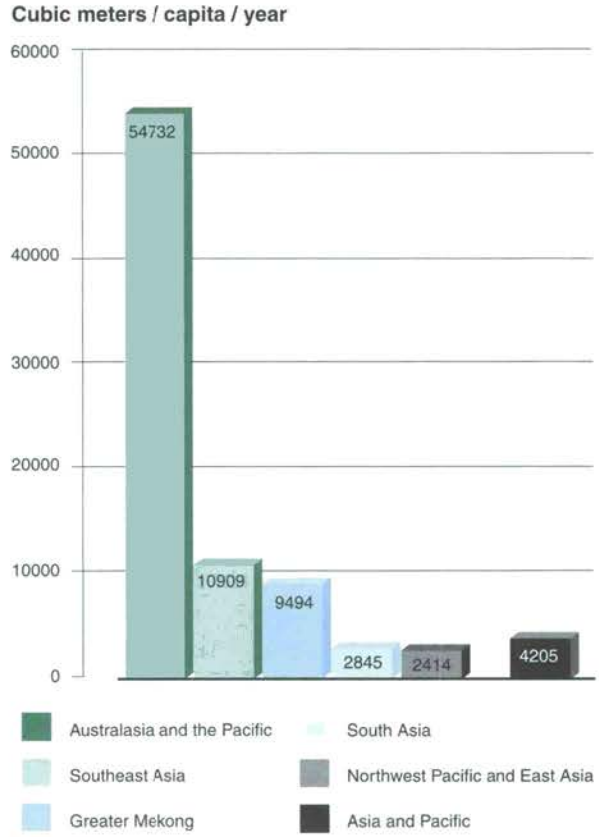
Water quality has been steadily degraded by a combination of factors, including saline intrusion, sewage and industrial effluents, and urban and agricultural runoff. The Asia-Pacific region had more

Figure 1.8: Annual Internal Renewable Water Resources in Asia, 1990 and 1995



Source: WRI (1992-93 & 1998-99)

Figure 1.9: Renewable freshwater resources



Source: GEO 2000

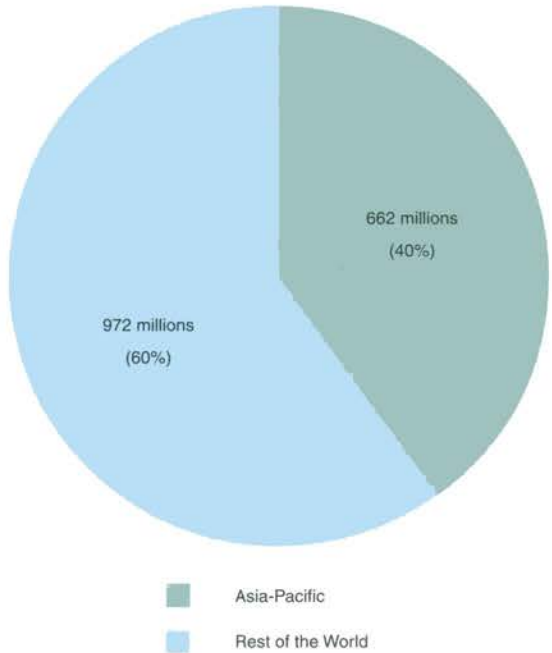
lakes and reservoirs with eutrophication problems (54 percent) than Europe (53 percent), North America (48 percent), South America (41 percent) and Africa (28 percent) (UNEP/ILEC, 1990). Levels of suspended solids in Asia's rivers almost quadrupled since the late 1970s (ADB, 1997; GEMS, 1996) and rivers typically contain 4 times the world average and 20 times OECD levels (GEMS, 1996). Suspended solid levels are highest in China (ADB, 1997).

Biochemical oxygen demand in Asian rivers is 1.4 times the world average and 1.5 times OECD levels. BOD levels declined in the early 1980s but increased in the 1990s because of increased organic waste loading. Asia's rivers contain three times as much bacteria from human waste (faecal coliform) than the world average and more than ten times OECD guidelines (ADB, 1997). The reported median faecal coliform count in Asia's rivers is fifty times higher than the WHO guidelines (ADB, 1997). Asia's surface water also contains 20 times more lead than surface waters in OECD countries, mainly from industrial effluents (ADB, 1997). Agrochemical inputs including fertilizers and pesticides and animal wastes from livestock raising are another growing source of freshwater pollution.

Asia's record with regard to safe water supply is very poor. One in three Asians has no access to a safe drinking water source that operates at least part of the day within 200 metres of the home (ADB 1997). Access to safe drinking water is lowest in Southeast Asia and South Asia. Almost one in two Asians has no access to sanitation services and only 10 percent of sewage is treated at primary level (ADB, 1997). Effluents flow straight into surface or groundwater. The situation is worst in South Asia and some Mekong countries (SEPA-China).

Dirty water and poor sanitation cause more than 500,000 infant deaths a year in the Asia-Pacific region, as well as a huge burden of illness and disability. According to WHO, diarrhea associated with contaminated water poses the most serious threat to health in the region. As presented in Figure 1.10, the region is accounted for more than 40 percent of the total global diarrhea episodes. In 1990, 1.7 million children in the region is group of below five years of age in eleven countries (India, Bangladesh, Bhutan, Indonesia, Maldives, Mongolia, Nepal, Sri Lanka, Thailand, DPR Korea and Myanmar) died of diarrhea, amounting to more than three children dying per minute.

Figure 1.10: Incidence of Diarrhoeal Diseases Among Children Below Five Years in Asia and the Pacific.



Source: WHO (1992)

South Asia and China are the most affected in the region by organic pollution, where the main sources are effluents of paper, pulp and food industries (UNEP, 1997). Excessive levels of nitrates resulting from fertilizer application and agricultural runoff are a major cause of eutrophication of surface water (ESCAP, 1995). Some arid countries, such as Iran and Afghanistan, suffer from chronic water shortages. Mismanagement of water resources over the years has depleted aquifers in countries such as India, Bangladesh and Sri Lanka. Bangladesh and some adjacent parts of India suffer from arsenic contamination of groundwater and related health impacts.

In Southeast Asia, the total annual internal renewable water resources are estimated to be 3,800 cu km (ASEAN, 1997). Annual internal renewable water resources per capita range from about 220 Cubic Metres per year in Singapore to 2,000 in Thailand, and 24,000 in Malaysia (ASEAN, 1997). Eutrophication of surface water bodies and pollution caused by pathogenic agents, organic matter and hazardous and toxic wastes is becoming a serious problem. While the main source of water pollution is from the industrial sector, untreated domestic wastewater, as well as chemical residue and animal wastes from agriculture, have increasingly threatened water quality in most major rivers. Faecal coliform counts and lead contamination are the worst in the region (ADB, 1997). During the 1990s, freshwater resources in the Mekong countries have suffered moderate to severe levels of eutrophication, nutrient loss, organic pollution, salinization, acidification, toxic metals, and microbial pollution. However, majority of water quality problems result from natural processes, particularly salt and acid-soil leaching and saltwater intrusion (MRC/UNEP, 1997b).

With population growth and industrial development, water demand in East Asia has increased drastically. Water shortages in some urban areas in Japan have occurred over the last few years, in part due to decreased rainfall, but the development of water recycling in industrial sectors has somewhat reduced pressure on freshwater resources. In Japan, heavy metals and toxic chemicals pollution have been reduced through compliance with and enforcement of regulations and standards for treating industrial wastewater but dioxin pollution is becoming an emerging issue (National Land Agency, Japan, 1997). Surface waters are still affected by organic pollution and are generally not improving, and in particular, the quality of lake water in a number of areas is deteriorating, resulting in eutrophication, offensive odors in drinking water, impaired filtering and harm to aquatic life (OECD, 1994). In China, freshwater demand and pollution have greatly increased in the past decade, due to rapid industrial, urban and modern agricultural developments. Annual water consumption is around 530 billion Cubic Metre, of which 78 percent is used for agricultural purposes and 22 percent for industry and domestic consumption. About 81 percent of the total fresh water resources are located in the south, where only 36 percent of the country's cultivated areas are located. Per capita average water resources are only one-fourth of the global average (2,344 Cubic Metre per capita) and the great pressure from China's dense population in urban areas is further aggravating water shortages. Groundwater resources are over-exploited and some of those that are used for drinking water are contaminated.

Land clearing has accelerated erosion rates in Australia, particularly on sloping lands. As a consequence, sediments from erosion continue to foul rivers, increase the cost of water treatment and reduce the storage capacity of dams and reservoirs. Water quality problems in Australia have been associated with nutrient and organic enrichment, pesticides, trace metals and industrial pollutants. In particular, high levels of phosphorous from run-off, erosion and point sources such as sewerage outlets, remain unacceptably high in rivers, lakes and reservoirs. In combination with reduced stream flows, these have resulted in extensive and frequent blooms of toxic blue-green algae.

Notably, the world's largest freshwater blue-green algal bloom to date occurred in November 1991 over 1,000 km of the Darling River. While drinking water quality in Australia is generally good, with over 95 percent of the population having water supplies that meet WHO guidelines, in some rural and remote aboriginal communities, however, it is less than satisfactory (Commonwealth of Australia, 1996).

In New Zealand, the dairy herd and the decline in the sheep flock have made significant impacts on water resources. The removal of sheep from steep pastures has allowed native vegetation and planted pine trees to take their place, reducing sedimentation rates in some catchments. Another development within the past decade has been the discovery of the infectious protozoan, Giardia lambdia, in New Zealand's waters and the finding that 40 percent of shallow lakes are nutrient enriched (eutrophic). Nonetheless, in 1997, 56 percent of New Zealanders were connected to safe water supply systems, 18 percent had unsafe systems, 8 percent had ungraded systems, and 15 percent were not connected to a community supply. The persistent El Nino conditions of the past decade have intensified water shortages in many areas leading local authorities to take more active conservation measures. As a result, water use in several regions actually declined in the late 1980s and early 1990s (New Zealand GEO-2 Input, 1998).

1.6 MARINE AND COASTAL ENVIRONMENT

1.6.1 Developments over the past 100 years

With more coastline than any other region in the world, the region's rich marine resources have provided a fundamental basis for development and livelihood and have proved central to economic growth. At the turn of the century, many countries in the region relied almost exclusively on both inland and marine fishery products as their sole source of protein and, in some cases, of foreign exchange. In the latter half of the century, the rapid expansion of the fisheries sector, together with significant population and industrial growth resulted in increased movement of people to coastal cities and the expansion of coastal urban conglomerations. Today, around a quarter of the world's 75 largest cities are situated along the region's coastline. This has significantly affected coastal and marine resources, resulting in increased domestic and industrial effluents, more areas of landfill, increased dredging, and the erosion of coastlines and coastal habitats. In addition, agrochemical pollution from intensified agricultural practices upstream, and the vast expansion of aquaculture production at the expense of mangrove forests have increased coastal and estuarine sedimentation and further degraded marine and coastal resources.

In South Asia, several of the region's key cities developed along the coast have become the centre of industry and commerce. Chemicals, heavy metals, wastes from pulp and paper mills and sugar factories, and oil spills have been the other major sources of marine pollution (ESCAP, 1990). In the coastal areas of Pakistan, depletion of mangroves, overfishing, water shortages and solid wastes have been the major environmental issues (Ghimire, 1995).

In Southeast Asia, with a total coastline of more than 80,000 kms, longer than the entire coastline of Europe, coastal resources have proved particularly important. At the turn of the century, households dependent on subsistence fishing used simple conservative fishing methods and small boats to earn a living. But exploitation of marine and coastal resources increased substantially after the middle of the century. In the inner Gulf of Thailand, after the introduction of trawlers in the 1960s, average fish catches per year increased from around 150,000 tonnes to 1.5 million tonnes in 1972. During the 1970s, rapid expansion of coastal urban centers, paddy rice cultivation and aquaculture production contributed significantly to the reduction of coastal habitats, particularly mangrove forests. In the Mekong basin, mangrove forests were degraded drastically, both in area and quality, particularly in the southern Mekong Delta. In Vietnam, for example, mangrove forests were depleted from 400,000 hectares in 1950 to just 252,000 hectares in 1983. This has indirectly affected the commercial demersal fisheries that rely on mangroves as nursery areas. In addition, the subregion's coastal environment has been affected by silt from unsound agricultural and logging practices. Two-thirds of the world's total sediment transport to oceans occurs in Southeast Asia as a result of a combination of active tectonics, heavy rainfall, substantial local relief with steep slopes and soil erosion (Millimen, J . D . et al, 1992).

In Japan and China, in the past 100 years, economic development was most active in the coastal zones. During the 1960s, concentrated heavy industries along Japanese coastal areas caused extreme water pollution, especially in semi-closed areas, which damaged fishery resources and resulted in red tides (JEC, 1997). But the implementation of strict laws and standards since the1970s has successfully improved the water quality of coastal areas. However, excessive land reclamation

practices and coastal developments have harmed fishery resources and destroyed coastal ecosystems, including an estimated 90 percent of coral reefs in the south and vast areas of mangrove forests (EA, 1997 and Research Group on Coral Reef Regions in Japan, 1990).

As an island continent with a long coastline (about 70,000 kms), Australia has many different types of marine and estuarine environments. Most are far from major population centers and are little affected by human activities. Large stretches of Australia's coastline are among the least-polluted places on earth. Australia has the third largest area of mangroves in the world, and the northern mangroves are among the most diverse. Australian waters also have the greatest diversity of seagrasses and some of the largest seagrass beds in the world. The dugong, listed by the IUCN as "vulnerable to extinction", prefers these seagrass habitats. But human activities have caused extensive localized losses of seagrass beds, saltmarshes and mangroves in Australia, particularly near major population centers (Commonwealth of Australia, 1996). Australia also has the largest area of coral reefs and the Great Barrier Reef (GBR) is an internationally well-known example. Its marine environment extends from its beaches, rocky shores and intertidal reefs to the boundary of its 200-nautical-mile Exclusive Economic Zone (EEZ). They include large areas of the seabed that are important for fishing, oil and gas production and possibly mining. Australia's estuaries are ecologically important habitats, usually rich in nutrients and with high productivity and biological diversity. Generally, however, Australia's marine waters are low in nutrients and therefore in productivity (Commonwealth of Australia, 1996).

Since European settlement, humans have changed coastal processes by clearing and developing land, using resources and changing the flow of rivers. The population of the non-metropolitan coastal zone has been growing at an unprecedented rate. Between 1971 and 1991 it grew by 95 percent (from 2.1 million to 4.1 million), while the total Australian population grew by 32 percent. The most severe pressures on the coastal environment have been related to residential development in the most accessible 10 percent of the coast, particularly those in the southeast. Between 1983 and 1990 more than three-quarters of all building approvals concerned the one-third of statistical districts that had coastal populations growing at more than double the national average rate between 1971 and 1991 (Australia SoE, 1996). One of the most serious large-scale threats to Australia's near-shore marine environment that has emerged is the input of excessive nutrients and sediments. In areas of high population density or intense human activity, marine and coastal environments are often being degraded as a result of urban, agricultural and industrial developments and tourist and recreational activities (Commonwealth of Australia, 1996). Soil erosion, fertilizer use, intensive animal production, and sewage and other urban and industrial discharges have increased the levels of nutrients (especially phosphorus and nitrogen) and sediments entering many bays and estuaries. High nutrient levels can promote algal blooms, and some of these are toxic. Each year Australia's sewerage systems discharge about 10,000 tonnes of phosphorous and 100,000 tonnes of nitrogen, much of which enter the sea. As much as 85 percent of nutrients come from catchment sources. Scientists have estimated that in Queensland, the amount of sediment, nitrogen, and phosphorus entering the sea each year have increased three-fold since the European settlement. Other pollutants include industrial chemicals and pesticides, heavy metals, pathogens (disease-causing micro-organisms) and litter. The rivers of Queensland's east coast catchments are estimated to deliver about 14 million tonnes sediment annually to estuaries and coastal marine waters - three to five times more than before the European settlement. Over the past 30 years, oil companies have drilled more than 1,100 wells offshore and extracted 2,800 million barrels of oil. However, their environment record has been very good, with only about 800 barrels of oil being spilt over this period.

Deforestation by early Maori communities appears to have led to a three- or four-fold increase in estuarine sedimentation in some areas of New Zealand (Hume and McGlone, 1986). In the past hundred years, intertidal sediments have been accumulating at a rate of 3-6 millimetres per year in sandy estuaries and 2-5 mm per year in muddy ones (Burns et al., 1990). This amounts to a sediment layer 20-60 cm deep deposited in New Zealand's estuaries over the course of the century. The disappearance of seagrasses in harbors and estuaries has also been attributed to declining water clarity, which is caused by sedimentation (Turner, 1995). In the past century, average sea temperatures have warmed by half a degree and New Zealand's sea level has risen by 15 centimetres (Hamiltonne, 1992). These changes may also be contributing to the spread of invasive seaweeds and toxic algae. Other significant developments this century include the growth of the fishing industry and the continuous expansion of urban areas near the coast, particularly estuaries. A survey covering about half the nation's estuaries undertaken 25 years ago by the New Zealand Ecological Society found that 38 percent of the estuaries were "clean", 41 percent "slightly polluted", 16 percent "moderately polluted" and 4 percent "grossly polluted" (McLay, 1976).

1.6.2 *Developments over the past 10 years*

Over the past decade, the situation in the region's coastal zones has improved in a few localities but, by and large, population growth, rapid urbanization, industrial expansion and the growth in trade in fisheries resources have taken their toll. From the 1980s on, marine fisheries production increased faster in the Asia-Pacific region than anywhere else in the world, at 2.8 percent compared with the world growth rate of 1.9 percent in 1992 (ESCAP, 1995). In the same year, the region accounted for 47.3 percent of the world total fish catch and eight countries from the Asia-Pacific were among the world's top 15 fishing nations (FAO, 1994). And during the period 1993-95, the region's share of world total fish catch averaged around 45.8 percent (WRI/UNEP/UNDP/WB, 1998). However, by the early 1990s, in many subregions, traditional marine fish stocks had reached full exploitation (FAO, 1991) and, in many areas, overfishing was already threatening the diversity and quantity of fish (ESCAP, 1992). For example, in the Northwestern Pacific off the Asian coast, 100 percent of assessed fish stocks have been exploited at or beyond sustainable limits.

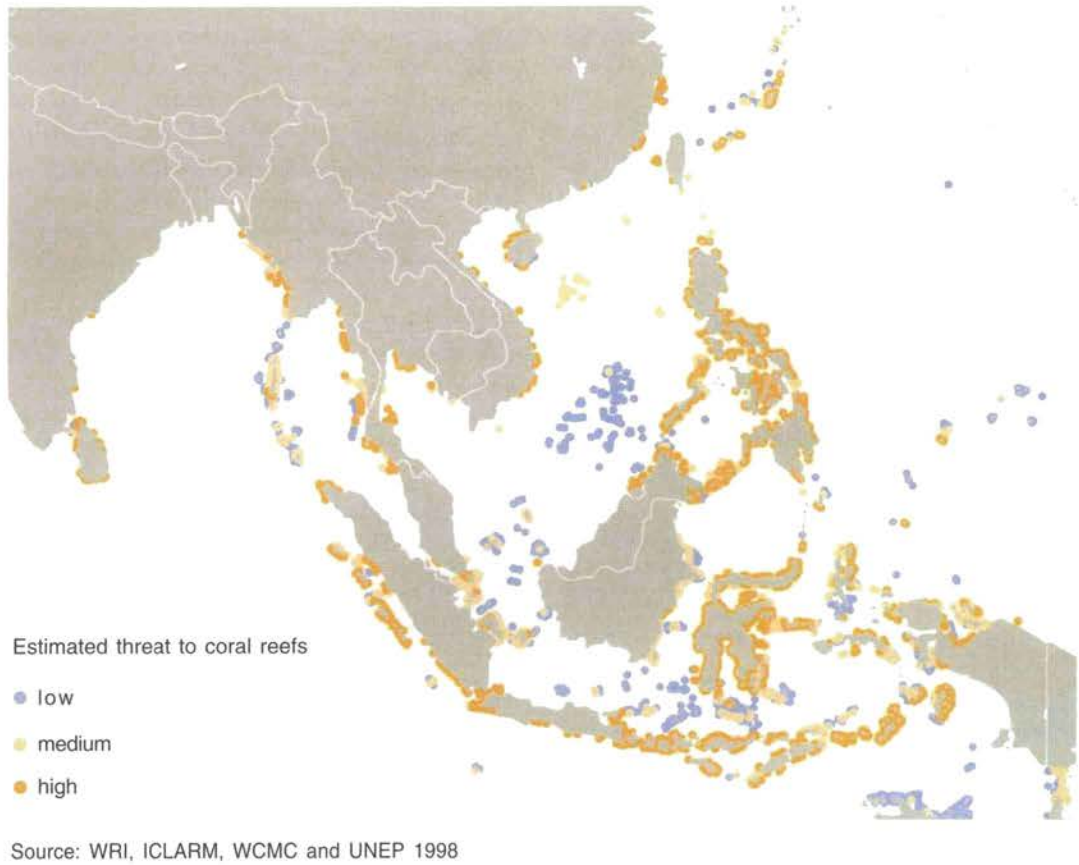
Aquaculture production also continued to increase over the last decade and contributed nearly one-quarter of Asia's total fish supply (FAO, 1995b). In 1992, the Asia-Pacific region provided 87 percent of global aquaculture produce (FAO, 1994). However, the uncontrolled expansion of aquaculture developments throughout the region has contributed to the further destruction of mangrove forests, conversion of wetland habitats, introduction of exotic species, increased use of chemicals (pesticides, antibiotics and hormones), degradation of water quality, and discharge of nutrients and other wastes.

Coastal and marine water pollution has increased, mainly due to direct discharges from rivers, increased surface run-off and drainage from expanding port areas, oil spills and other contaminants from shipping, and domestic and industrial effluents. Asian rivers account for nearly 50 percent of the total sediment load (13.5 billion tonnes per year) transported by the world's rivers (UNEP, 1992) and are generally heavily contaminated with untreated sewage and industrial effluents. In addition, the expansion of intensive agricultural practices upstream has resulted in increased agrochemical pollution, particularly in developing countries of the region. Fertilizer consumption in the Asia-Pacific region rose by 74 percent over the period 1982-92 (ESCAP, 1995) and pesticide use has increased four-fold since 1977 (Holmgren, 1994). Increasing marine-based tourism, particularly the construction of hotels, beach clubs, marinas, has degraded marine and coastal environments, particularly coral reefs, through infilling, dredging and the resuspension of contaminated silts. Coastal erosion resulting from increased land subsidence from groundwater extraction, sediment starvation as a consequence of inland dam and irrigation barrage construction, offshore mining of sand and dredging are notable problems in some localities in the region. The increase in marine and coastal degradation has already had a negative impact on the region's biodiversity and threatens the future economic exploitation of marine and coastal resources. The continuing expansion of aquaculture production is affecting 90 percent of fish species that depend on coastal habitats at some period in their lives. In addition, the widespread felling of mangrove forests has reduced coastal protection from cyclones and storm surges, increased seawater intrusion and acidified surface waters (Lean et al, 1990). Red tides also have become an environmental problem of major concern. Destructive fishing techniques, pollution, sedimentation and the crown of thorns have destroyed many reefs in East Asia. Figure 1.11 shows the areas under varying degrees of threat.

In South Asia, increasing pesticide pollution has contaminated shell and finfish. India alone uses 55,000 tonnes of pesticides a year, of which 25 percent are thought to end up in the sea (WRI/UNEP/UNEP, 1990). An estimated 1,800 tonnes of pesticides enter the Bay of Bengal each year (Holmgren, 1994). Oil pollution along major shipping routes is also a significant problem. In the port of Chittagong in Bangladesh, about 6,000 tonnes of crude oil are spilled a year and crude oil residue and wastewater effluent from land-based refineries amount to about 50,000 tonnes per year (Khan, 1993). Beach tar is also a severe problem along the west coast of India, with total deposits of up to 1,000 tonnes a year (GESAMP, 1991). In Bangladesh, India and Sri Lanka, substantial areas of mangrove forests have been lost to the construction of shrimp ponds and for paddy rice cultivation (UNEP, 1997). Marine-based tourism is increasing throughout the sub-region. In the Maldives, for instance, marine-based tourism now accounts for more than 19 percent of the country's GDP and 30 percent of government revenues. The number of tourists arriving each year exceeds the indigenous population and tourism has become a major source of both economic growth and environmental degradation (Government of Maldives, 1997).

In Southeast Asia, pressure on the marine and coastal environment has reached critical levels as a result of rapid population and economic growth since the 1980s. Without appropriate economic development strategies,

Figure 1.11: The threat to coral reefs



Source: GEO 2000

impoverished coastal inhabitants have exploited coastal resources without much regard for sustainability and this, together with uncontrolled pollution, has resulted in the loss of critical ecosystems. Marine fish production has been an important source of economic growth. Between 1979 and 1994, the average annual marine fish catch increased from 4.2 to 7.7 million tonnes - nearly 10 percent of the world harvest and slightly more than 20 percent of the catch in Asia (WRI, 1996). However, by the early 1990s, the volume of fish catch was already approaching the marine fisheries' "biologically realizable potential" of between 5.8-7.8 million tonnes per year (ASEAN, 1997). Depletion of economically important fish stocks was approaching critical levels for some species, such as Skipjack tuna or penaeid shrimps, and inshore stocks of demersal fish were also heavily exploited (FAO, 1994). In Thailand and Vietnam, coastal and marine overfishing is already serious, and is getting worse in Cambodia (Development Alternatives, Inc. 1995). In the Mekong basin, destructive fishing practices, such as the use of explosives and chemicals, have endangered coral reefs while in Myanmar the rate of fishing appears to be within sustainable limit.

As a result of the vast expansion of aquaculture production, more than 3 million hectares of Southeast Asia's mangrove forests have been destroyed. The rich coastal resources and mangrove forests of Thailand have been devastated by over exploitation and encroachment. Coastal fishing, coastal aquaculture (especially shrimp farming), and mining are the main causes of this destruction. The once extensive mangrove forests along the coast of Thailand dropped from nearly 368,000 hectares in 1961 to 160,000 hectares in 1996 (OEPP, Thailand, 1998).

Rapid coastal urbanization and industrial expansion have brought increasing amounts of raw sewage and industrial wastes, including mine tailings and toxic wastes, which have polluted coastal waters. Sediments carried by flood runoff from degraded upland watersheds have silted coastal waters. In Malaysia, the damage to fisheries from siltation exceeds the damage caused by bacterial contamination from sewage (FAO

1993). In the Philippines, the combined effects of sediments, industrial and domestic pollutants, and destructive fishing techniques, such as the use of dynamite and poisons, have damaged some 70 percent of the country's coral reefs. This has affected local self-sufficiency in many communities since Filipinos derive nearly half of their protein from fish (FAO, 1993b). In addition, an outbreak of red tides in the Philippines in 1990 caused further economic losses to the fish and shellfish industries (ESCAP, 1995). Marine transportation, offshore mineral exploration and production activities are further sources of pollutants. Southeast Asian seas are among the world's busiest maritime traffic routes and the occurrence of oil spills is becoming a major concern with an increasing number of accidents in recent years.

In East Asia, the main sources of coastal pollution are inland wastewater, solid wastes, organic pollutants and toxic materials and, out at sea, oil spills and pollution from shipping, offshore mineral exploration and production activities, and ocean dumping of toxic and nuclear wastes. Despite the development of sewage systems in Japan and the consequent reduction in the amount of nutrients discharged, eutrophication in semi-closed ocean areas such as Tokyo Bay is still serious and red and blue tides have harmed fisheries in these areas. Red tides in Japanese coastal areas damaged an estimated 1.6 billion Japanese yen worth of fisheries resources in 1990 (OECD, 1994). In Japan and in the Republic of Korea, oil pollution from shipping and accidental oil spills has been frequently reported. The open ocean of the Sea of Japan/East Sea contains 1.5-1.8 times more oil than the surface of the northwestern Pacific Ocean. In China, in the last ten years, the marine industry has become a new field of economic growth. However, the frequency of red tides has been increasing, with a total of 19 incidents in 1993. The number of incidents in Tolo Harbour, Hong Kong, increased from two in 1977 to nine in 1994 (ESCAP, 1995). By the end of 1997, China had announced 34 Class 3 zones for dredged materials. A small amount of pulverised coal ash and dredged material had been dumped into the sea in the past. But China strictly bans the disposal of any radioactive wastes at sea and no toxic and nuclear wastes are dumped at sea (SEPA, China, 1998).

The continuing increase in nutrient loads has been recognized as the most significant pressure on Australia's marine and coastal ecosystems. In 1994, sewage effluents contributed some 10,000 tonnes of phosphorous and 100,000 tonnes of nitrogen. Introduced plants and animals also have damaged marine and coastal environments. At least 55 species of marine fish and invertebrates, plus several seaweeds, have been introduced into Australia, either intentionally for aquaculture, or accidentally in ships' ballast water or encrusted on their hulls. These are damaging localized marine and coastal environments. The population explosion of the crown-of-thorns starfish has, on several occasions, destroyed localized parts of the Great Barrier Reef Park. Although Australia's reefs are still in good condition, they are now however exposed to significant pressures, with those close to population centers and tourism activities showing the most signs of damage. Further specific information on the GBR Marine Park is provided in Box 1.2 below.

With the exception of turtles and possibly dugongs, which remain at risk, reptiles (the saltwater crocodile) and mammals (whales and seals) that have been overhunted in the past are now recovering. Despite having the third largest Exclusive Economic Zone (EEZ) in the world, Australia is a minor player in terms of overall fish catch, not even ranking in the world's top fifty fishing nations. This is largely because Australia's waters are generally less productive than most, which means Australia must be particularly careful in ensuring that fishing yields are sustainable. Nonetheless, commercial fishing, involving many of the high-value species such as prawns, lobsters, abalone and tuna, is currently valued at around $1.6 billion per year and employs some 25,000 people directly. Fishing, both commercial and recreational, imposes heavy pressure on marine species and their habitats. Comprehensive data on fishing effort are not available in Australia; however, the increase in total landings of commercial species over time provides a crude estimate of increased pressure on fish stocks. For example, the total Australian fish catch including crustaceans and molluscs increased from 73,000 tonnes in 1964-65 to 215,000 tonnes in 1995-96 (Australia GEO-2 Input, 1998). Most major Australian seafood species are now fully fished (BRS, 1997). Furthermore, some species have been overfished, including the southern bluefin tuna, the eastern gemfish, the orange roughy, tiger prawns and the school shark (Commonwealth of Australia, 1996; BRS, 1997).

Estuarine contamination has been steadily increasing in New Zealand, particularly in the Auckland region. Although there has been a steady fall in contamination from pesticide residues, such as DDT and chlordane, concentrations of heavy metals and hydrocarbons have steadily increased. About half of Auckland's 3,500 hectares of coastal sediment has excessive concentrations of lead, zinc and copper, with circumstantial evidence of reduced animal diversity, elevated contaminant levels in shellfish and crustaceans,

Box 1.2: The Great Barrier Reef

The Great Barrier Reef (GBR) - the largest system of coral reefs in the world - is about 2,500 km in length and comprises 2,900 separate reefs and 940 islands. Its high species diversity includes more than 400 species of corals, 4,000 species of mollusks, 1,500 species of fish, 6 species of turtles, 35 species of seabirds and 23 species of sea mammals. Internationally recognized as one of the world's best tourist attractions, the area is Australia's premier marine tourism destination. The combined value of tourism and fishing on the GBR is estimated to be around one billion dollars per year.

The GBR is one of the least-disturbed coral reef systems in the world and much of it is still in relatively good condition. Evidence is growing of coral mortality on the tops of some inshore reefs but the evidence is patchy and not consistent for all reef tops for which there are historical photos. Possible causes include cyclones and increased sediments and nutrients. Recent evidence from long-term monitoring (Sweatman, 1997) also suggests that the Whitsunday and Pompey sectors of the GBR are showing signs of degradation: hard coral and fish appear to be reduced in this sector compared with other parts of the GBR. The causes of this are unknown, but do not appear to be related to the crown-of-thorns starfish or to cyclones. However, consistently higher than average concentrations of chlorophyll are found in these sectors. Over the past 30 years the crown-of-thorns starfish has damaged nearly 20 percent of reefs, largely in the central one-third of the GBR. Damage in affected areas ranges from slight to very severe. In the Innisfail, Townsville and Cape Upstart sectors of the GBR, coral cover has increased, after being affected by crown-of-thorns starfish in the 1980s (Sweatman, 1997). It is still not known what causes crown-of-thorns outbreaks.

The main pressures on the GBR include: declining water quality in inshore areas, due mainly to elevated sediments and nutrients from changes in land use in coastal catchments; fishing, particularly trawling of the sea floor and overfishing of reef species; coral mortality caused by outbreaks of the crown-of-thorns starfish; storm events; potential threat of oil and chemical spills and ballast water from shipping; and the effects of tourism. About two million people visit the GBR and its adjacent coast annually and the number of visitors is increasing by 10 percent each year (30 percent in the Cairns area).

Source: Commonwealth of Australia, 1996

and changes in their growth or behaviour. The heavy metals come from leaded petrol, tyres (zinc), and vehicle wiring (copper). At present, they are not at levels which threaten aquatic life, but they are increasing (Wilcock, 1994). The phasing out of leaded petrol between 1986 and 1996 is causing a slow decline in lead pollution but, if the other contaminants continue to be generated at current rates, the proportion of contaminated estuarine sediment will expand from 50 percent to 70 percent by the year 2021 (Auckland Regional Council, 1994). Smaller poisoning outbreaks have recurred throughout the 1990s (New Zealand GEO-2 Input, 1998).

1.7 ATMOSPHERE

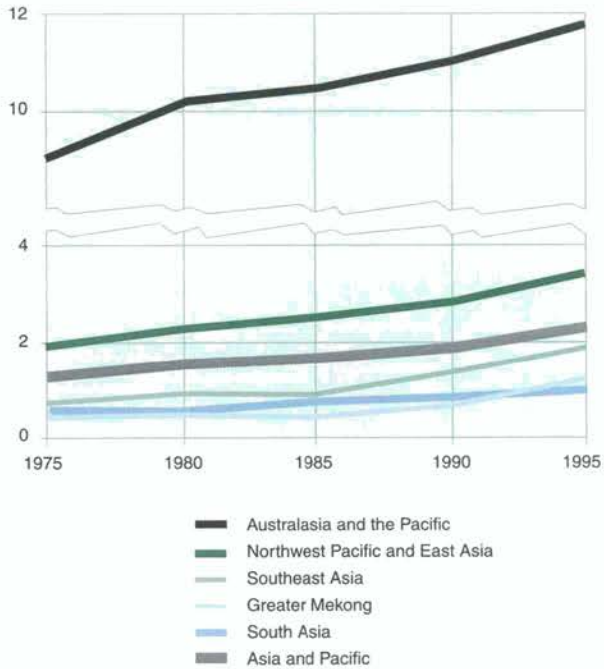
1.7.1 Developments over the past 100 years

In the last quarter of the century, atmospheric pollution increased significantly in the Asia-Pacific region largely as a result of escalating energy consumption due to rapid economic growth and the more widespread use of motor vehicles. Per capita commercial energy use more than doubled in most parts of the regions between 1975 and 1995. Figure 1.12 shows the annual commercial energy consumption per capita across the region. In 1995, the region accounted for 26.8 percent of the world's commercial energy consumption and half of it generated from coal burning. Insert text from Sub 8

Commercial energy in most parts of the region increased three-fold during the period 1971-90 (IEA, 1994). From 1970, sulfur oxides (SO_x) emissions in Asia increased by 80 percent - at least 4 times the rate of any other region - from 11.25 million in 1970 to 20 million tonnes of sulfur (S) equivalent in 1986 (Hameed and Dignon, 1992). Nitrogen oxide (NO_x) emissions from fossil fuel combustion increased by about 70 percent from 3 million to 5.1 million tonnes of nitrogen (N) equivalent (Hameed and Dignon. 1992). However, total emissions were significantly less than that of North America and Europe during the same period.

In South Asia, Southeast Asia and China, the rapid growth in energy demand due to urbanization and the associated development of industry and transport systems resulted in the emergence of air pollution problems. Coal, particularly, has been the dominant fuel in South Asia and China. Significant health threats also arose from the use of low-quality traditional solid fuels, such as wood, crop residues and dung, for cooking and heating in lower-income urban households and rural areas throughout the region.

Figure 1.12: Annual commercial energy consumption per capita



Source: GEO 2000

In Japan, modernization began in the middle of the 19th century, culminating in an intensive period of industrialization, urbanization and rapid economic growth during 1955-64. Energy consumption, mainly of coal, almost tripled from 51.3 million tonnes in 1955 to 145.8 million tonnes in 1965 (calculated in terms of oil) and air pollution problems were at their peak in the 1960s. However, during the past two decades, Japan successfully reduced emissions of SO_2, NO_x and CO by technological innovation, institutional development, and cooperation by all levels of government and industry. Sulfur dioxide emissions, for example, decreased nearly 40 percent between 1974 and 1987 (WRI/UNEP/UNDP, 1992). In the Republic of Korea, air pollution problems started in the late 1960s with the operation of heavy industries and reached their peak in the 1970s and 1980s. Since then, however, average concentrations have been declining as a result of the increasing use of low-sulfur oil and liquefied natural gas. But in Korea DPR, total emissions of CO_2 and NO_x increased constantly between 1975 and 1985.

Pollution problems in Australia have been episodic, influenced by seasonal and meteorological factors (Australia GEO-2 Input, 1998). While monitoring covers only 5 percent of the country by area, it is known that in the more remote areas where there is little human activity, air quality has always remained good. However, emissions of greenhouse gases have grown over the last 30 years principally because of population growth, industrialization and continuing electrification. A significant feature of the Australian climate is its large year-to-year variability. Australia's climatic variability comes about partly because the continent lies near the "center of action" of the so-called Southern Oscillation, which occurs about once every two to seven years. Every few years, the surface waters in the central and eastern Pacific undergo a remarkable warming known as El Ni?o, which leads to substantial changes in the atmospheric circulation throughout the entire Asia-Pacific region. In the period 1952-93, mean temperatures across Australia showed consistent warming in the range of 0.1 to 0.2°C per decade and above 0.2°C per decade for a broad zone across the country. By contrast, a cooling trend was observed earlier in the century (1910-51). The observed warming over the past few decades is mainly due to an increase in nighttime air temperatures. The diurnal temperature range (the difference between the daytime maximum and the overnight minimum temperatures) decreased over Australia during 1951-1993, with the largest decrease of about 0.4°C per decade occurring in the northeast interior. The major El Nino Southern Oscillation (ENSO) related drought of 1982-83 was marked by severe bushfires in southeastern Australia. And in January 1994 fires that produced smoke haze and aerosols devastated vast areas of New South Wales (Australia SoE, 1996).

Winter air pollution, mostly from coal and wood-burning fires in private homes, has been a persistent problem in Christchurch for most of this century, and an occasional problem in some other towns and cities of New Zealand. From the limited monitoring done, it appears that some air pollutants have declined since the 1970s (particulate matter, smoke, sulfur dioxide and lead), some have worsened (benzene, carbon monoxide and smog) and some show no change (oxides of nitrogen). Recent monitoring suggests that carbon monoxide emissions from motor vehicles may have increased in many cities, particularly where high traffic density and low wind speeds allow fumes to build up. The number of licensed vehicles in New Zealand has grown at more than twice the rate of the human population. While human numbers increased by 18 percent between 1972 and 1995, car numbers rose by 46 percent. Given the rise in the number of vehicles, it is no surprise that the greatest growth in energy consumption between 1980 and 1995 was in the transport sector, whose share of total consumer energy rose from around 30 percent to 36 percent. Another source of greenhouse gases that has increased during this century is livestock. Between 1900 and 1995, sheep

numbers more than doubled and cattle numbers increased seven-fold. Taken together, the increases in energy use, motor vehicles and livestock suggest that carbon dioxide and methane emissions have risen steeply this century. New Zealand's climate has also changed. Temperatures warmed faster than the global average, gaining 1.1°C since 1860, compared to the world's 0.7°C. Most of this warming has occurred in the last 50 years (New Zealand GEO-2 Input, 1998).

1.7.2 *Developments over the past 10 years*

The extent of air pollution varies considerably across Asia as presented in Table 1.1, but is worse in urban areas and increasing most rapidly in developing countries in the region. The major causes of increasing air pollution are increasing energy demand and consumption, the use of poor quality fuels such as coal with a high sulfur content, inefficient methods of energy production and use, increasing numbers of vehicles, traffic congestion, poor automobile and road conditions, use of leaded fuel and inappropriate mining methods, resulting in emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), suspended particulate matter (SPM), lead (Pb), and carbon monoxide (CO_2). Forest fires are also contributing significantly to the region's air pollution.

Table 1.1: Relative Severity of Air Pollution in Asian Sub-regions

Pollutant	South Asia	Southeast Asia	East Asia	China	India
Sulfur dioxide	x	xx	xxx	xx	xx
Particulates	xxx	xx		xx	xx
Lead	xx	xxx		x	x

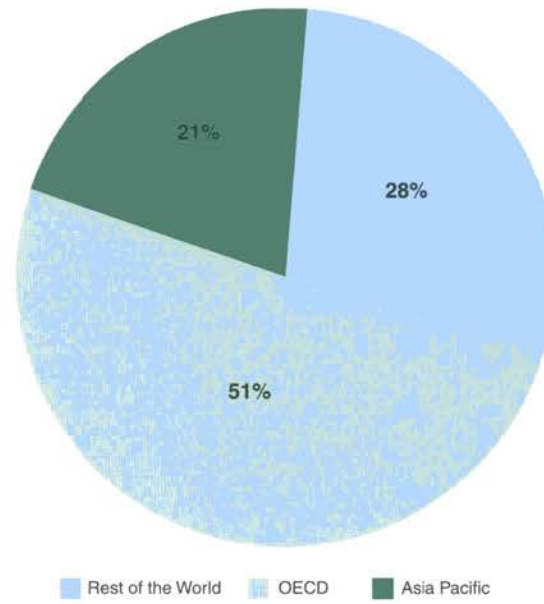
xxx = very severe; xx = severe; x = moderate but rising

Sources: GEMS (1996), WB (1995), WRI (1996), ADB (1997)

Asian region, excluding Japan, Australia and New Zealand, accounted for 21 percent of the world's primary commercial energy demand in 1992 as shown in Figure 1.13. While global energy consumption fell by 1 percent per year between 1990 and 1993, Asia's energy consumption grew by 6.2 percent a year (ADB, 1997). Fossil fuels now account for about 80 percent of energy generation in Asia, with coal accounting for about 40 percent. The region also accounted for about 41 percent of global coal consumption in 1993 (EIA, 1995).

While per capita emissions of Carbon dioxide are little more than half the world average, they grew twice as fast as the world average during 1975- 95. Figure 1.14 shows per capita carbon dioxide emission across Asia and the Pacific region. In 1990, China and Japan became the first and second largest CO_2 emitters, respectively, in the region. But CO_2 emissions per capita are still low, less than half of the world average and only 15 percent of the level in OECD countries (ADB, 1997).

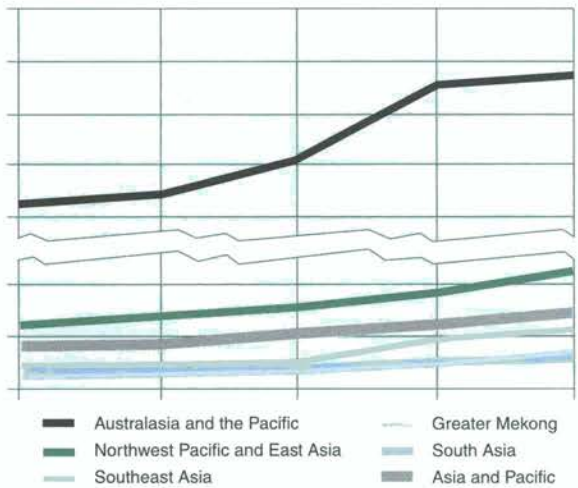
Figure 1.13: Share of World Energy Demand, 1992



Source: ADB, 1994a

Two of Asia's giant economies, China and India, rely heavily on coal for energy. Over the past decade, raw coal with high sulfur content has accounted for 75 percent of China's energy resources, emitting 18 million tonnes of SO_2 into the atmosphere annually. About 90 percent of China's total sulfur dioxide emissions come from coal burning (SEPA-China) (State Planning Commission, 1997). This is among the highest levels of SO_2 emissions in the world. For the 22 countries of Asia, total emissions of SO_2 were estimated to be 38 million tonnes in 1990, almost 56 percent higher than those of North America and 50 percent higher than in either Africa or Latin America. They were however still only one-third of the level in industrial countries (ADB, 1997). As evident from Table 1.2, three of Asia's 11 megacities exceeded the World Health Organization (WHO) guidelines for acceptable SO_2 levels (WHO and UNEP, 1992). About 78 percent of these emissions originated from East

Figure 1.14: Carbon dioxide emissions per capita



Source: GEO 2000

Asia (China, Republic of Korea, Japan and Mongolia) (SEPA-China). With increasing SO_2 emissions, acidification is emerging as an issue throughout the region. The areas with the lowest critical loads (i.e. up to 320 milligrams per square metre) and most sensitive to acidic deposition are in South China, southeast Thailand, Cambodia and South Vietnam (Hettelingh et al., 1995).

Table 1.2: Air Quality in 11 Mega Cities of the Asia and the Pacific Region

City	SO2	SPM	Lead	CO
Bangkok	L	H	M	L
Beijing	H	H	L	L
Bombay	L	H	L	L
Calcutta	L	H	L	L
Delhi	L	H	L	L
Jakarta	L	H	M	M
Karachi	L	H	H	L
Manila	L	H	M	L
Seoul	H	H	L	L
Shanghai	M	H	L	L
Tokyo	L	L	L	L

Note:

H: Serious problem. WHO guidelines exceeded by more than a factor

M: Moderate to heavy pollution. WHO guidelines exceeded up to a factor

L: Low pollution. WHO guidelines are normally met or may be exceeded

Source: WHO, UNEP, 1992

Transportation contributes the largest share of air pollutants to the urban environment of Asia's megacities. Table 1.4 shows that three of Asia's 11 megacities exceed WHO guidelines for acceptable lead levels, and two exceed acceptable ozone and sulfur dioxide levels (WHO and UNEP, 1992) NO_2 is also increasing, especially in Japan and in the Republic of Korea. The estimated total number of registered vehicles in the region in 1992 was over 130 million with an annual growth rate of 3 percent to 4 percent. Lead pollution is a particular problem in megacities of Southeast Asia but the introduction of unleaded fuels is reducing average levels, although the rate of decline is slower in Asia than elsewhere.

Ten of Asia's 11 megacities exceed WHO guidelines for particulate matter by a factor of at least 3 (WHO/UNEP, 1992) and 13 of the 15 dirtiest cities ranked by the total range and average level of particulate pollution were in Asia (WHO and UNEP, 1987). The level of ambient particulates, i.e. smoke and dust, which are a major cause of respiratory diseases, are generally twice the world average and more than five times as high as in industrial countries and Latin America (ADB, 1997). In Hanoi, Hai Phong, Ho Chi Minh City, in 1995-96, the concentration of particulates in the atmosphere of populated areas around heavily polluted industrial areas exceeded the Vietnamese standards by 4-6 times while the concentration of SO_2 by 2-3 times (MoSTE, Vietnam 1997). In South Asia, fly ash generated through the mining of coal has emerged as a significant problem, particularly in India, where the situation is serious. An estimated 35-40 million tonnes of fly ash are generated by thermal power plants every year, and only 2-3 percent is being reused (UNEP 1997).

Recent epidemiological studies have shown that smoke and dust particles, especially smaller particles below 10 microns in diametre (referred to as PM10) and in particular the finest particles below 2.5 micron in diametre (PM2.5), significantly affect human health. Acute respiratory infections (ARI), including pneumonia, bronchitis, and tuberculosis, the most prevalent traditional diseases, are aggravated by air pollution in general, and in particular by indoor air pollution from biomass fuel (wood, crop residues, and dung) used widely in lower-income urban households and rural areas throughout the region. According to WHO estimates, Bangladesh, India, Nepal, and Indonesia together account for about 40 percent of the global mortality in young children caused by pneumonia, with infant mortality rates above 40 per 1000 live births (WHO. 1993). In China, smoke and

small particles from burning coal cause more than 50,000 premature deaths and 400,000 new cases of chronic bronchitis a year in 11 of its large cities (WB, 1997).

Indonesia forests fire has greatly affected the air pollution levels in South East Asia Box. 1.3 highlighted the forest fire of Indonesia. Smoke is also detected in Australia.

Box 1.3: Indonesian Forest Fires

The Indonesian forest fires that have been burning since September 1997 due to careless management of land clearance in Kalimantan and Sumatra have greatly increased pollution levels in Southeast Asia, releasing an estimated 110-180 million tonnes of CO_2 to the atmosphere (WWF). The area affected by both CO_2 and other air pollutants from the fire has spread to more than 3,200 kilometres east to west, covering six Southeast Asian countries and perhaps affecting 70 million people. Smoke from the fires was experienced as far south as Darwin, Australia (Australia GEO-2 Input). Peak levels of particulates in Kuala Lumpur, Singapore, and many Indonesian cities reached more than 6,000 micrograms per Cubic Metreetre (WB, 1997a). The air pollution index (API), which is a measure of SO_2, NO_2, CO, ozone and dust particles, reached a critical level of 288 micrograms per Cubic Metres on 26 September 1997 in Betonneg district in Southern Thailand (Bangkok Post, 27 September 1997). In the Malaysian State of Sarawak, the API hit a record 839 on 23 September 1997. Levels as low as 100 to 200 are considered as "unhealthy" and anything over 301 is equivalent to smoking 80 cigarettes a day and is "hazardous".

Source: Bangkok Post, WWF and World Bank

Motor vehicles are the single most important source of air pollution in Australian cities since only a small number of heavy industries are situated within the urban air sheds. In general, the concentrations of common air pollutants (e.g. SO_2, CO_2, NO_x, ozone, suspended particulates and lead) in major Australian cities meet National Health and Medical Research Council (NH&MRC) guidelines. They are also generally lower than WHO standards. Over the last decade, some aspects of air quality in major cities of Australia, like Sydney and Melbourne, have improved. However, episodic pollution sometimes occurs in major cities, principally due to Australia's generally sunny climate, which promotes the formation of ground level ozone and photochemical smog. For example, between 1980 and 1996, one- hour concentrations of ozone in the greater metropolitan region of Sydney exceeded the WHO goal of 0.08 ppm on at least 6 days per year and up to 45 days per year (NSW EPA, 1997). Atmospheric lead levels have declined significantly due to the phase-out of leaded fuels since 1986, and the levels of carbon monoxide and total suspended particulates are also likely to fall further. Sulfur dioxide is not a major pollutant in urban areas because of the low sulfur content of Australian fuels and the location of most power stations outside the cities. There is no evidence of significant acid (wet) deposition in Australia. Australia's net greenhouse gas emissions in 1995 amounted to 402 million tonnes, measured as carbon dioxide equivalent, a 6 percent increase from 1990. Australia contributes about 1.4 percent of global greenhouse emissions. The majority of emissions from the energy sector come from stationary energy (primarily electricity generation) with an increase of 17 million tonnes (8.4 percent) from 1990 to 1995. Over the same period, transport emissions (mainly passenger vehicle usage) increased by 7 Million tonnes (11.6 percent). Fugitive emissions decreased between 1990 and 1995 by 0.4 Million tonnes (1.5 percent). Agriculture emissions showed a slight decline from 88.8 Million tonnes in 1990 to 87.4 Million tonnes in 1995, mainly due to a reduction in livestock numbers during most of the period and a reduction in crop production. Waste emissions increased from 14.8 Million tonnes in 1990 to 16.4 Million tonnes in 1995, reflecting a growing population (Australia GEO-2 Input, 1998). Preliminary evidence suggests a significant drop in emissions from land clearing activities between 1990 and 1995 of about 38 million tonnes, owing mainly to the diminishing effect of extensive past (1960s and 1970s) land clearing on soil carbon emissions caused by disturbing the soil during clearing.

Recent monitoring in some cities of New Zealand has revealed high carbon monoxide levels in heavy traffic corridors when wind speeds are low and traffic density high. Benzene levels have risen moderately since the banning of leaded petrol in 1996. Annual gross carbon dioxide emissions increased by 7 percent between 1990 and 1995, and were projected to increase by 12 percent by the year 2000. On a per capita basis, New Zealand emissions of carbon dioxide are 25 percent lower than the OECD average, but about 50 percent higher than the global average. Carbon dioxide is not the only New Zealand greenhouse gas to have increased in the past decade. The following also increased between 1990 and 1995 and are expected to keep increasing: carbon monoxide (CO_2); other non-methane carbon gases (nmvocs); sulfur dioxide (SO_2); the nitrogen oxides (NO_x); and hydrofluorocarbons (HFCs). CFC use per capita has also declined over the past decade (New Zealand GEO-2 Input, 1998).

REFERENCES

ADB (1994a). Energy Indicators of Developing Member Countries of ADB, Energy and Industry Department, Asian Development Bank, Manila

ADB and ASEAN (1994). Climate Change in Asia: Thematic Overview, Asian Development Bank, Manila

ADB (1995). Key Indicators for Developing Asian and Pacific Countries, Asian Development Bank, Manila.

ASEAN (1994). ASEAN Strategic Plan of Action on the Environment, ASEAN Secretariat, Jakarta

Auckland Regional Council (1994). ASP Ecological Impact Evaluation, Unpublished report by ARC Environment Division, Auckland Regional Council, Auckland

Bangkok Post, 27 September 1997. Bangkok, Thailand

Burns, N.M., Hume, T.M., Roper, D.S., Smith, R.K. (1990). Estuaries pp 81-84 in Climatic Change: Impacts on New Zealand, (Impacts Working Group, New Zealand Climate Change Programme) Ministry for the Environment, Wellington

Braatz, S. (1992). Conserving Biological Diversity, A Strategy for Protected Areas in the Asia-Pacific Region, World Bank Technical Paper No. 193

Brown, L. (1995). Who will Feed China? Wake up Call for a Small Planet, The World Watch Institute. Washingtonne, D.C.

BRS (1997). Status of Fisheries Reports 1997, Resource Assessments of Australian Commonwealth Fisheries, Bureau of Resource Sciences, DPIE, Canberra, Australia

Center for Applied Economics (1996). A Project for Preparation of National Action Plan for Agenda 21, a report submitted to Office of Environmental Policy and Planning (in Thai)

Chou, L.M., Goh, B.P.L. and Lam, T.J. (1998). Environmental Protection and Biodiversit Conservation in Singapore, In: G. Ismail and M. Mohamed (eds.), Biodiversity Conservation in ASEAN: Emerging Issues and Regional Needs, pp.214-232. London. ASEAN Academic Press

Commonwealth of Australia (1997a). Australia's First Approximation Report for the Montreal Process, Montreal Process Implementation Group for Australia, Canberra, Australia

CSE (1997). Down to Earth, Center for Science and Environment, New Delhi. India, 31 August

Cunha, L.V. da. (1989). Sustainable Development of Water Resources, International Symposium on Integrated Approach to Water Pollution, Lisbon

Dearden, P. (1996). Biodiversity in the Highlands of Northern Thailand: Some Research Approaches in Biodiversity in Asia: Challenges and Opportunities for the Scientific Community, Proceedings of a Conference on Prospects of Cooperation on Biodiversity Activities, Chiang Rai, Thailand 15-19 January Development Alternatives, Inc. (DAI) (1995). East Asia Country Environmental Profiles, United States Agency for International Development, Regional Support Mission for East Asia, Bangkok, Thailand

EEPSEA and WWF (1998). The Indonesian Fires and Haze of 1997: The Economic Toll, Interim Report, WWF Indonesia and EEPSEA (Economy and Environment Programme for Southeast Asia), Singapore

ESCAP (1991). Desertification through Wind Erosion and its Control in Asia and the Pacific, United Nations, New York

ESCAP (1993). The State of Urbanization in Asia and the Pacific 1993, UN, New York

EIA (1995). International Energy Annual: 1993, Energy Information Agency, U.S. Department of Energy, Washington

FAO (1991). Recent Developments in World Fisheries, FAO, Rome

FAO (1993). Indo-Pacific Fisheries Commission: Papers Presented at the Seventh Session of the Standing Committee on Resources Research and Development, Bangkok

FAO (1993a). Forest Resources Assessment 1990: Tropical Countries. FAO Forestry Paper 112, Rome

FAO (1993b). Marine Fisheries and the Law of the Sea: A Decade of Change, FAO Fisheries Circular No. 853, FAO, Rome

FAO/RAPA (1994). Selected Indicators of Food and Agricultural Development in Asia and the Pacific Region, 1983-1993, Publication 1994/24, Bangkok

FAO/UNDP/UNEP (1994). Land Degradation in South Asia: Its Severity, Causes and Effects upon the People, World Soil Resources Report No. 78, FAO, Rome

FAO (1995a). Forestry Statistics Today for Tomorrow, FAO, Rome

FAO (1995b). Review of the State of World Fishery Resources: Aquaculture, FAO Fisheries Circular No. 886, FAO, Rome

FAO (1996). Selected Indicators of Food and Agriculture Development in Asia-Pacific Region, 1985-95, FAO Regional Office for Asia and the Pacific (RAPA), Bangkok

FAO (1997a). State of the World's Forest 1997, FAO, Rome

FAO (1997b). Provisional Outlook to 2010

FAO (1997c). FAO - APFSOS Working Paper No. 19: Wood Materials from Non-Forest Areas

FAO (1997d). <http://www.fao.org/>

Gadgil, M and Guha, R (1992). Ecological History of India, Delhi, Oxford University Press

GEMS (1996). Airs Executive International Programme (http://ww.epagov/airs/aeint), World Health Organization

GEMS-GEMS (1996). Water Programme (http://cs715.cciw.ca/gems/atlas-gwq/gems2.htm/), United Nations Environment Programme and World Health Organization

GESAMP (IMO, FAO, UNESCO, WMO, WHO, IAEA, UN, UNEP) (1991). Joint group of experts on the scientific aspects of marine protection, reducing environmental impacts of coastal acquaculture, Reports and Studies No 47, FAO, Rome

GESAMP (1993). Joint group of experts on the scientific aspects of marine protection, impact of oil and related chemicals and wastes on the marine environment, Reports and Studies No 50, IMO, London

Government of People's Republic of China (1996). Statistical Year Book of China

Government of Bangladesh (1994). Country Presentation of Bangladesh, 1994 Regional Meeting on the State of the Environment in Asia and the Pacific, Myanmar

Government of Korea Rep. (1991). Ministry of Environment, 1991 National Report of the Republic of Korea to UNCED 1992

Government of Korea Rep. (1994). Ministry of Environment, Environmental Protection in Korea

Government of Korea Rep. (1997). Ministry of Environment, Environmental Protection in Korea

Government of Malaysia (1992). Annual Fisheries Statistics of Malaysia 1988-92

Government of Maldives (1994). State of the Environment Maldives 1994, Ministry of Planning, Human Resources and the Environment, Male, Republic of Maldives

Government of Pakistan (1994). Country Report on State of Environment in Pakistan presented at Regional Meeting on the State of the Environment in Asia and Pacific, Myanmar, 1994

Government of Sri Lanka (1994). State of the Environment of Sri Lanka, Ministry of Environment and Parliamentary Affairs, Colombo, for Submission to the SACEP, Colombo, Sri Lanka.

Government of Thailand (1992). National Report to the United Nations Conference on Environment and Development. June 1992

Government of Viet Nam (1994). State of the Environment Report of Viet Nam 1994, MoSTE, Vietnam

Government of Viet Nam (1997). State of the Environment Report of Viet Nam 1997, MoSTE, Vietnam

Hamiltonne, D.J. (1992). Sea Level Rise is for Real, pp 339-347 in Proceedings: Annual Conference, Vol 1, General and Civil, The Institution of Professional Engineers, Wellington Hameed, S. And Dignon, J. (1992). Global Emissions of Nitrogen and Sulfur Oxides in Fossil Fuel Combustion, 1970-86, J. Air Waste Management Association, 42, 159-63

Hettelingh, J.P., M Chadwick, H Sverdrup and D Zhao, (1995). RAINS-ASIA: An Assessment Model for Acid Rain in Asia (Chapter 6), Report from the World Bank sponsored project Acid Rain and Emissions Reduction in Asia

Holmgren S. (1994). An Environmental Assessment of the Bay of Bengal Region, Bay of Bengal Programme, BOPG/REP/67, BOBP, Madras.

Hume, T.M. and McGlone, M.S. (1986). Sedimentation Patterns and Catchment Use Change Recorded in the Sediments of a Shallow Tidal Creek, Lucas Creek, Upper Waitemata Harbour, New Zealand, New Zealand Journal of Marine and Freshwater Research, Vol 20: pp 677-687

IEA (International Energy Agency) (1994). World Energy Outlook, OECD, Paris

ICOLD (1984). World Register of Dams - 1984, Central Office, International Commission on Large Dams, Paris

ICOLD (1989). World Register of Dams - 1988 Updating, Central Office, International Commission on Large Dams, Paris

IDE (Institute of Developing and Economies in Japan) (1997). IDE Spot Survey, Kim Il's North Korea, Japan.

IUCN (1986). Review of Protected Area Systems in the Indo-Malayan Realm, IUCN

JEC (Japan Environmental Council) (1997). Asia Kankyo Hakusho 1997-98, Toyoshinsya, Japan

JEC (Japan Environmental Council) (1997). Asian Environmental Report 1997/98 (in Japanese)

Jones, J.B. (1992). Environmental Impact of Trawling on the Seabed: a Review, New Zealand Journal of Marine and Freshwater Research, Vol 26: pp 59-67

Kantaiheiyo-mondai-kenkyusho, Kankoku-kitachosen Soran (1993). Volume 3, Japan

Khan, M.A. (1993), Problems and Prospect of Sustainable Management of Urban Water Bodies in the Asia and Pacific Region, Bangkok

Kummer D.M. (1993). Trends in Land Use and its Impact: an Attempt at Sub-global Explanation, in Rural Land Use in Asia and Pacific, a report of an APO symposium, 29th September - 6th October, 1992, Asian Producitivity Organization, Tokyo

Lean, G, Hinrichsen, D and Markham A. (1990). Atlas of the Environment, WWF World-Wide Fund for Nature and Arrow Books Ltd., London

MacKinnon, J. (1994). Analytical Status Report of Biological Conservation in Asia-Pacific Region, Biodiversity Conservation in Asia-Pacific: Constraints and Opportunities, Proceedings of a Regional Conference

McNeeley, J.A., K.R. Miller, W.V. Reid, R.A. Mittermeier, and T.B. Werner (1990). Conserving the World's Biological Diversity, WRI, World Conservation Union, World Bank, WWF-U.S. and Conservation International, Washingtonne and Gland, Switzerland

McLay, C. (1976). An Inventory of the Status and Origin of New Zealand Estuarine Systems, Proceedings of the New Zealand Ecological Society, Vol 23: pp 8-26

Millimen, J.D. et al, (1992). Cited in UNEP/GEMS Website,(http://cs715.cciw.ca/gems/atlas-gwq/images/ref1.gif)

Milliman J.D and Syvitki, J.P.M. (1992). Geomorphic/Tectonneic Control of Sediment Discharge to Ocean: The Importance of Mountainous River, International Journal of Geology, 100, 5, pp 525-54

Ministry of Environment Korea (1990) (1995). Environment Statistical Yearbook

Ministry of Health and Family Welfare (1998). Arsenic Contamination Mitigation Project, Bangladesh

MNE (1996). Nature and Environment in Mongolia, Ministry of Nature and Environment, Ulaanbaatar (in Russian)

MNE, UNDP, WWF (1996). Mongolia's Wild Heritage, Ministry of Nature and Environment, Mongolia, Ulaanbaatar

MRC (1997). *Mekong River Commission Annual Report 1997, Bangkok, Thailand*

MRC (1997). Mekong River Basin Diagnostic Study: Final Report, MRC, Bangkok, Thailand

National Land Agency (NLA) (1997). Water Resources in Japan 1997 (in Japanese)

NESDB (1992). Office of the National Economic and Social Development Board, National Urban Development Policy Framework, Final Report: Volume 1, Thailand

Norman O. (1993). The Environment and Economic Policy Trends of Pakistan, Journal of International Development, 5:2, 225-235

NSW EPA (1997). New South Wales State of the Environment 1997, NSW Environment Protection Authority, Sydney, Australia

OECD (1994). OECD Environmental Performance Reviews: Japan, Paris, France

OECD (1997). OECD Environmental Performance Reviews: Korea Republic, Paris, France

OEPP Thailand (1998). Thailand's State of the Environment Report 1995-1996, Executive Summary, p 4, Thailand

Oldeman, L.R., Hakkeling, R.T.A. and Sombrock, W.G. (1990). World Map of the Status of Human Induced Soil Degradation, An Explanatory Note, ISRIC/UNEP, Wageningen, Netherlands

O'Hare, N. (1996). Bottom line, Listener, Vol 154 (8-14 June): pp 18-21

Osborne, M. (1995). Southeast Asia, an Introductory History, Sixth Edition, Silkworm Book

Pasuk Phongpaichit and C. Baker. (1995). Thailand Economy and Politics, Oxford University Press, Kuala Lumpur

Pham, N.D. (1990). Some Investigations on the Air Pollution in Vietnam Cities, Scientific Papers presented to the International Conference on Environment and Sustainable Development, Hanoi

Pham, N.D. (1995). Present State of Air Pollution in Cities and Industrial Zones of Vietnam, in V.S., Cao (edition), Thegioi Publishers, Hanoi

Probert, P.K. (1996). Trawling the Depths: Deep-sea Fishing off New Zealand may have Long-lasting Effects, New Zealand Science Monthly, Vol 7 (8): pp 9-10

Research Group on Coral Reef Regions in Japan (1990). Tropics in Japan: Natural History of Coral Islands, Japan

Samar Singh (1994). The Biological Value of the Asia-Pacific Region, Biodiversity Conservation in Asia-Pacific: Constraints and Opportunities, Proceedings of a Regional Conference

Science and Technology Agency (1992). Energy Utilization in Asia and the Global Environment SPC (1995). State Planning Commission Report on China's Population, Resources and Environment, China Environmental Sciences Press, Beijing

SSB (1997). State Statistical Bureau, China Statistical Yearbook, China Statistical Publishing House, Beijing

State Planning Commission (1997). China's Energy Development Report, Economic Management Press, Beijing

Straits Times (1993). 3 June 1993, Indonesia

State Statistical Office of Mongolia (1996). Mongolian Economy and Society in 1995, Ullanbaatar

Sweatman, H. (1997). Long-Term Monitoring of the Great Barrier Reef, Status Report, Number 2, Australian Institute of Marine Sciences & CRC: Reef Research Center & the Great Barrier Reef Marine Park Authority, Townsville, Australia

Uhlig, H. (1984). ed., Spontaneous and Planned Settlement in Southeast Asia, Publication of the Institute of Asian Affairs, Hamburg

UNCTAD (1994). UNCTAD Commodity Year Book

UN/ESCAP (1995). Statistical Year Book for Asia Pacific Region 1994, New York

UNEP (1992). Marine Pollution from Land-based Sources: Facts and Figures, UNEP Industry & Environment, Paris

UNEP (1993). Environmental Data Report 1993-1994, UNEP, Nairobi, Kenya

UNEP (2000). Global Environment Outlook 2000, Earthscan, London

V.S. Cao (1995). The System of Protected Areas in Vietnam in V.S. Cao (edition), Thegioi Publishers, Hanoi

Water Resources Department of Japan (1997). Their Consumption, Development, and Preservation, Japan Land Agency, Japan

WCMC (1992). Global Biodiversity: Status of Earth's Living Resources, World Conservation Monitoring Center, Cambridge, U.K

WCMC (1994). The Socialist Republic of Vietnam: An Environmental Profile, World Conservation Monitoring Center, Cambridge, UK

WHO (1993). The Work of WHO in South-East Asia Region, 1 July 1991-30 June 1993, New Delhi, India

Wilcock, R.J. (1994). Organic Pollutants in Sediments of Manukau Harbour, in Proceedings of the First AgResearch/Landcare Research Pesticide Residue Workshop 1994, edited by L. Boul and J. Aislabie, 1995. (AgResearch Information Series, no. 1) New Zealand Pastoral Agriculture Research and Landcare Research Institute, Lincoln.

World Bank (1995). World Tables Diskette 1995, Washington D.C.

World Bank (1997). World Development Report 1997, Washington D.C.

World Bank (1997a). Can the Environment Wait? Priorities for East Asia, Washington D.C.

World Bank (1997b). Environment Matters: Towards Environmentally and Socially Sustainable Development, The World Bank Group, Washington D.C.

World Bank (1997c). RAINS-ASIA: An Assessment Model for Acid Deposition in Asia, Washington D.C.

WHO (1993). The Work of WHO in Southeast Asia Region, 1 July 1991-30 June 1993. New Delhi

WHO (1992). CDD Programme Report

WHO and UNEP (1987). Global Pollution and Health, Yale University Press, London

WHO and UNEP (1992). Urban Air Pollution in Megacities of the World, Blackwell, Oxford, U.K.

WRI (1987). World Resources 1987-88, Washington D.C.

WRI/UNEP/UNDP (1990). World Resources 1990-91: A Guide to the World Environment, Oxford University Press, New York and London

WRI/UNEP/IUCN (1992). Global Biodiversity Strategy: Guidelines for Action to Save, Study and Use Earth's Biotic Wealth Sustainably and Equitably, WRI, Washington, D.C.

WRI/UNEP/UNDP (1994). World Resources 1994-95: A Guide to the World Environment, Oxford University Press, New York and London

WRI/UNEP/UNDP/WB (1996). World Resources 1996-97: A Guide to Global Environment, Electronic Database, Oxford University Press, New York

WRI/UNEP/UNDP/WB (1998). World Resources 1998-99: A Guide to Global Environment, Electronic Database, Oxford University Press, New York

CHAPTER 2

Driving Forces of Changes

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2.1 INTRODUCTION

Asia is in the midst of an economic and social transformation unparalleled in history. In the last half-century, in East and Southeast Asia especially, rapid industrialization and high rates of economic growth have changed virtually every dimension of life. Yet, by many measures - of health, education, nutrition, as well as income - the quality of life within Asia generally remains poor. At least one in three Asians has no access to safe drinking water and at least one in two has no access to sanitation (ADB, 1997). Average cereal consumption remains at one-third of that in developed countries and average food availability, as a proportion of required daily intake, is low in many countries. Literacy rates remain low, particularly for women (ADB, 1997). Above all, poverty remains a significant problem. It is estimated that three-quarter's of the world's poor live in Asia and that over 50 percent of the world's population living in below absolute poverty levels are in South Asia alone (ESCAP, 1995). Overall, progress in South Asia, in particular, has lagged behind the rest of the region. In most countries, industrialization has exerted a heavy toll on the environment.

At the turn of the century, environmental degradation in the Asia-Pacific region was largely due to poor farming methods, such as slash and burn agriculture, colonial expansionist land practices (South and Southeast Asia), and foreign invasions and mineral exploitation (China). Following World War II, in East Asia, structural adjustment and economic development led to the rapid growth of the commercial and services sector in Japan and, with increased GDP, a concomitant improvement in health, education and nutrition standards. The founding of the People's Republic of China in 1949 and the introduction of an ambitious programme of industrial and social development brought about major changes. In Southeast Asia, industrial expansion and increasing participation in international trade fuelled rapid economic growth from the early 1980s on. Change has been slower to come in South Asia where it is only in recent years that structural adjustment programmes and economic liberalization have begun to be implemented.

The environmental problems in Asia-Pacific countries emerge from increasing population pressure over a limited resource base; widespread poverty; exploitation of natural resources and industrialization in the quest for economic development; and rapid urbanization. Other problems include desertification, deforestation and land degradation. Deforestation, cultivation of steep slopes, poor drainage system and inadequate soil conservation has all contributed to soil degradation. As a result of growing population pressure, the need for greater food production has led to a retreat of forest and woodlands for agriculture and settlements. Excessive cutting of industrial timber and urban expansion are also major driving forces to deforestation. The coastal and marine environment is a major area of concern, particularly for island countries and coastal cities. The movement of people to coastal cities has caused increased domestic and industrial effluents, more areas of landfill, more mangrove clearance, more discharge of agrochemicals and increased erosion of coastlines. The destruction of wildlife habitat and fishery resources are also critical. Environmental problems, including the deterioration of water and air quality, and threats to biodiversity are priority concerns for all countries of the region.

Since Stockholm Summit in 1972, most of the countries in the Asia-Pacific region have formulated many environmental laws to safeguard environment and health of the people. The role of these laws included: a) provide an institutional mechanism for pursuing environmental policies; b) setting up standards for safe environment; c) promote environmentally sound technology; d) practice environmental impact assessment to integrate environmental issues in developmental planning; e) promote people's participation in planning and implementation process; and f) keep provision for punishment for violation of environmental standards. In spite of the institutional and administrative constraints for implementation of environmental laws, the laws have played an important role in protecting human health and environment.

2.2 SOCIO-ECONOMIC DEVELOPMENTS

Table 2.1 shows that economic growth rates have varied dramatically throughout Asia in the last decade. The fastest growing economies were in China and Southeast Asia (Thailand), both of which registered almost 9 percent average annual growth. Sub-regional averages of per capita GNP range from the highest, US$800 in East Asia, to the lowest, US$350 in South Asia (World Bank, 1997).

Table 2.1: Growth of Per Capita GDP and Openness to Trade: Regional Comparison

	World	East Asia	Southeast Asia	South Asia
Per Capita GDP Growth Rate (1965-1990)	1.9 percent	6.7 percent	3.8 percent	1.7 percent
Openness to Trade	0.43	0.97	0.73	0.06

Source: ADB (1997)

Increasing industrialization and international trade largely fueled economic growth in the region. Table 2.2 shows that during 1980 to 1995, the share of the industrial and services sectors in the region's total GDP increased significantly with the exception of Mekong basin countries, while the agricultural sector declined. In 1960, three out of four working Asians were employed in agriculture; by 1990 this share fell to around 62 percent of the labor force. Over the same period, the share of people working in industry grew from around 15 percent to 21 percent in Asia (ADB, 1997). The dramatic economic growth rates of the early part of this decade have been followed by equally dramatic economic slumps, particularly in countries of Southeast Asia.

Despite recent events, overall economic growth has been accompanied by some improvement in health and education, although the region as a whole still lags far behind the developed world. Adult literacy varies greatly across the region, from 85 percent female illiteracy in Afghanistan and 59 percent male illiteracy in Nepal, to countries such as Republic of Korea and Japan, where for both sexes, these numbers are below 5 percent (UNESCO, 1995). During the last five years (1990-95), life expectancy for males has increased from 63.6 to 65.0 years, and for females from 65.9 to 67.0 years. There has been a marked decline in the infant mortality from 68 per 1000 live births in 1990 to 59 per 1000 in 1995. But there exits a great disparity in the region in terms of infant mortality, which varies from 80 per 1000 live births in South Asia to 25 per 1000 live births in Pacific (ESCAP, 1995).

However, the advantages of rapid economic growth have not filtered down to all levels of society. Poverty remains a significant problem, particularly in South Asia where there are more than 560 million poor people (UNDP, 1996) with around 39 percent of the population already below the poverty line, and numbers continue to increase as seen in Figure 2.1. In countries such as India, it has been argued that because the economic reform process began at an overall lower level of social development than in, for example, Southeast Asia, a large percentage of the population has been excluded from sharing the benefits, and consequently economic disparities have tended to widen (Dreze and Seen, 1996).

Rural poverty, together with rapid industrialization, has led to significant rates of rural-urban migration. In the region as a whole, the rate of increase in urban populations (46.7 percent) is significantly higher than the global average (29.3 percent) although at 34.1 percent the regional percentage of urban population remains lower than the global average of 44.8 percent.

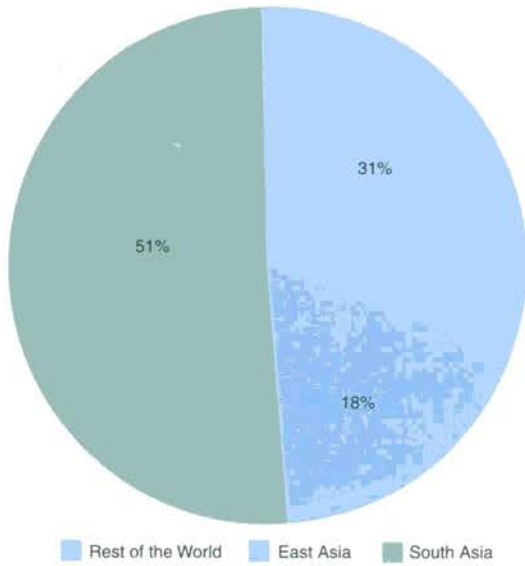
Throughout the Asia-Pacific region, pressure on land resources is extreme with roughly 58 percent of the world's population depending upon only about a quarter of the world's land area (ESCAP, 1995). The number of landless households in the region is increasing, particularly in South Asia. In addition, the region's overall population growth rates are higher than the world average of 1.6 percent, particularly in South and Southeast Asia. Figure 2.2 presents population

Table 2.2: Structure of the Economies of South and East Asia

	Agriculture		Industry		Services	
	1980	1995	1980	1995	1980	1995
East Asia	27 percent	18 percent	39 percent	44 percent	34 percent	38 percent
South Asia	39 percent	30 percent	26 percent	29 percent	35 percent	41 percent

Source: World Bank (1997)

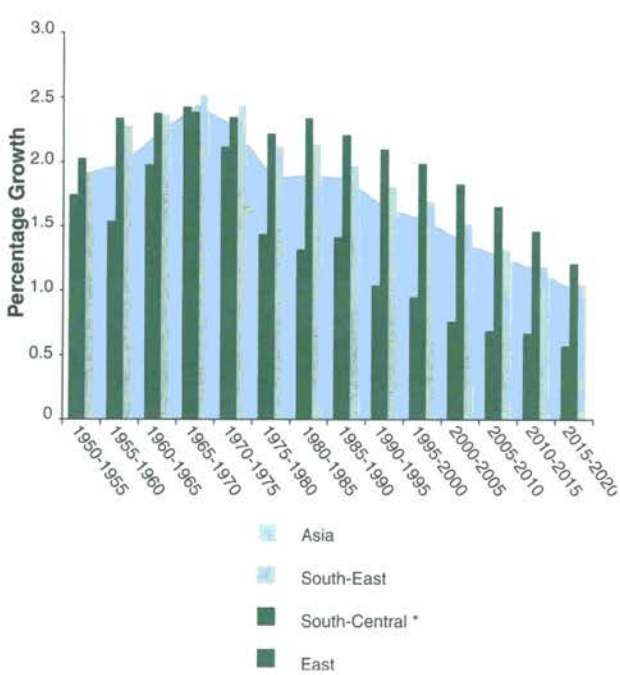
Figure 2.1: Distribution of population below absolute poverty level



Source: ESCAP (1995)

growth rates for 1950-2015 (medium variant projections for 1990-2015). Although population growth rates have declined slightly in recent years, a large portion of the population is in the pre-reproductive age groups, particularly in parts of South and Southeast Asia, which could lead to sharp increases in population growth in the near future.

Figure 2.2: Population Growth Rates, 1950-2015



*Note: *South Central includes Central Asian Republics*
Source: Worl Population Propoects, 1994 Revision

The combination of high population density and growth, rapid industrialization and urbanization, and poverty has taken its toll on the region's natural resource base and speeded up the process of environmental degradation. Overall, estimates of the economic costs of environmental degradation in Asia range from one to nine percent of a country's Gross National Product (ADB, 1997).

Environmental experts are far from agreeing on the relative significance of the various causes of environmental degradation (ADB 1994b). Rapid population growth is often blamed but five countries (China, Indonesia, Malaysia, Myanmar and the Philippines) all show declining population growth rates yet account for 80 percent of deforestation in Asia (ADB, 1997). Economic growth is also cited as a cause yet it seems that rising incomes eventually herald improvements as growing popular demand for a better environment forces a favorable policy shift. This point is not far off for Asia's more prosperous newly industrialized economies (ADB, 1997).

Overall, it would appear that Asia's environmental crisis is in large part the result of market and policy failures, neglect and institutional weaknesses. Only in East Asia have some countries succeeded in their attempts to implement wide-ranging policies to comprehensively reverse the trend of continuing environmental degradation. China, for example, achieved significant progress in preventing and treating industrial pollution, improving urban environments and has initiated ecological forestry, water, soil and species conservation programmes.

In South Asia, many countries are in the process of structural adjustment programmes geared towards restoring fiscal and macro-economic balances, liberalizing industrial and trade policies and, in general, releasing the potential of private entrepreneurship. However, fiscal and macro-economic imbalances still tend to loom large: India, for example, has been unable to lower its fiscal deficit to targeted levels of 4-5 percent of GDP per annum. Whereas economic growth in Bhutan and Sri Lanka has been fueled by both tourism and the expansion of agro-exports, in Maldives it has been fueled by tourism only (ADB, 1994). In general, the effects of economic liberalization have yet to be felt. Population growth rates and densities remain among the highest in the world. Although India and Sri Lanka have achieved relatively low growth rates of 1.8 percent and 1.2 percent per annum, respectively, most countries still have populations growing at rates of between 2.8-5 percent per annum. In 1995 countries such as Bangladesh, India

and Sri Lanka had as many as 9,252, 3,147 and 2,840 persons per 1000 hectares respectively in 1995 (World Resources Institute, 1996) and Bangladesh, India and Pakistan together had 30 million landless households. The combination of already dense populations, high population growth rates, poverty, widespread land degradation and increasing water scarcity bodes ill for future food security in the subregion. In addition, an emerging environmental concern is the glacier outbursts in the Himalayas, Nepal and Bhutan.

In Southeast Asia, economic growth rates in the last 10 years varied between 1.7 percent per year in the Philippines to almost 9 percent in Thailand, with a subregional average of 7-10 percent growth over the past three years. However, there was a wide discrepancy between average national per capita incomes ranging from $250 in Myanmar to around US$3,000 in Thailand. Throughout the subregion, industry's share in GDP increased dramatically from 26-36 percent in 1970 to 34-54 percent in 1993, mainly as a result of growth in the manufacturing and services sectors. Over the same period, the share of agriculture in GDP declined to less than 25 percent everywhere, except in the Mekong basin countries where it still accounts for 40-55 percent of total GDP. Economic growth has brought about improvements in public facilities and welfare and as a result life expectancies in some countries are now comparable with those of middle and high income countries. However, the rapid growth of the industrial and urban sectors has led to a substantial increase in both atmospheric and other pollution, particularly solid, water, hazardous and toxic wastes. In addition, rural poverty, together with population pressure, has forced people to move to ecologically fragile areas. Other significant environmental problems in Southeast Asia include land-use change from deforestation and land clearance for commercial and shifting agriculture, and from mangrove clearance for the expansion of the aquaculture industry. Many forests have been depleted to critical levels. Population growth and density is also a matter of concern, particularly for some Mekong basin countries.

In East Asia, Japan and China were among the first industrialized economies in the region. In Japan, the commercial and services sector now accounts for about 90 percent of the total labor force with agriculture representing just 5.9 percent. The Japanese people are among the healthiest, best fed, best housed and most educated in the region and the scourge of poverty has largely receded. China recorded one of the highest economic growth rates in the world between 1986 and 1996, with a GDP annual growth rate of about 9.9 percent (SEPA-China). Elsewhere in East Asia, Mongolia's market economy is now growing rapidly after declining between 1990 and 1993 when economic liberalization programmes were first implemented. Economic depression continues in Korea DPR, despite the rapid development of heavy industries in the last decade, particularly minerals and metals. Natural disasters like flood etc. also contributed to this problem in Korea DPR (Korea DPR). In East Asia, the most pressing environmental problems are air and water pollution, land degradation caused by deforestation and improper agricultural practices, urban wastes, noise pollution, soil erosion, water loss, and desertification, all of which have become obstacles to economic development.

In the past ten years, Australia's economy has grown faster than the OECD average. According to Commonwealth of Australia (1998a), the Australian economy experienced strong growth between 1986 and 1996. GDP(averaged) in 1996-97, calculated using average 1989-90 prices, amounted to $A 444 641 million (or $A 24 300 per capita)- an increase of 36.3 percent from 10 years earlier. However, the economy has fluctuated considerably, with recessions occuring in the mid-1970s, early 1980s and early 1990s. Although the service sector dominates the Australian economy with 71 percent of GDP, Australian output is relatively environment intensive compared with other industrialised countries (OECD, 1998). For instance, Australia wool and wheat account for 40-50 percent and 14 percent of world exports, respectively. Australia is also the largest producer of bauxite, alumina, lead and diamonds, and ranks second for iron ore, third for gold, fifth for aluminium and seventh for black coal, and produces about 17 percent of the world's uranium.The 18 countries that make up the Asia-Pacific Economic Cooperation (APEC) region, especially Japan, are Australia's main trading partners, accounting for over 72 percent of the country's trade. The USA, followed by New Zealand is another important trading partner with Australia (OECD, 1998). Pressures on the environment and natural resources from agriculture, manufacturing, the energy sector, transport, tourism and mining continued to grow, constituting a major challenge for Australia. For example, the tourism industry is largely based on natural resources, and is rapidly growing. The number of international visitors to national and State parks and reserves has increased considerably to more than 1.5 million per year. Several critical environmental issues may be identified in Australia. These include: the general lack of a systems-based approach to environmental management; the absence of some representative ecosystems in national parks; land clearing and habitat modification for agriculture (cropping and pasture production) and through urban expansion, particularly in coastal areas;

over-allocation of freshwater to consumption; groundwater "mining" as well as rising groundwater through land clearing activities; dryland and irrigated cropping area salinity; accelerated soil erosion; some pollution of coastal waters; introduced species within all ecosystem types; and overfishing of some commercial marine stocks (Commonwealth of Australia, 1996).

New Zealand responded in the 1980s with wide-ranging free-market reforms. The social impact of the economic reforms has been to increase inequality, with more hardship and fewer services for those on lower incomes and more freedom, opportunity and lifestyle choices for those on higher incomes. Absolute poverty is still extremely rare, but relative poverty (i.e. insufficient resources to participate fully in society) has risen in the past decade. The Government's Social Policy Agency found that, between 1987-88 and 1992-93, the proportion of all households with incomes below the Benefit Datum Line (BDL) increased from 9.8 percent to 19.5 percent (Krishnan, 1995). By 1996 it had settled back to 16 percent. The percentage of Maori households below the BDL went from 13 percent to 34 percent, and Pacific Island households went from 15 percent to 41 percent. Households with children were disproportionately affected. In 1987-88, 11 percent of households with children were below the BDL. By 1992-93 this had risen to 29 percent - encompassing a third of the nation's children (Eastonne, 1995). In 1994, during a period of unusual economic growth, its Real GDP per person ranked 24th in the world and its Human Development Index (HDI) ranking was ninth (UNDP, 1997).

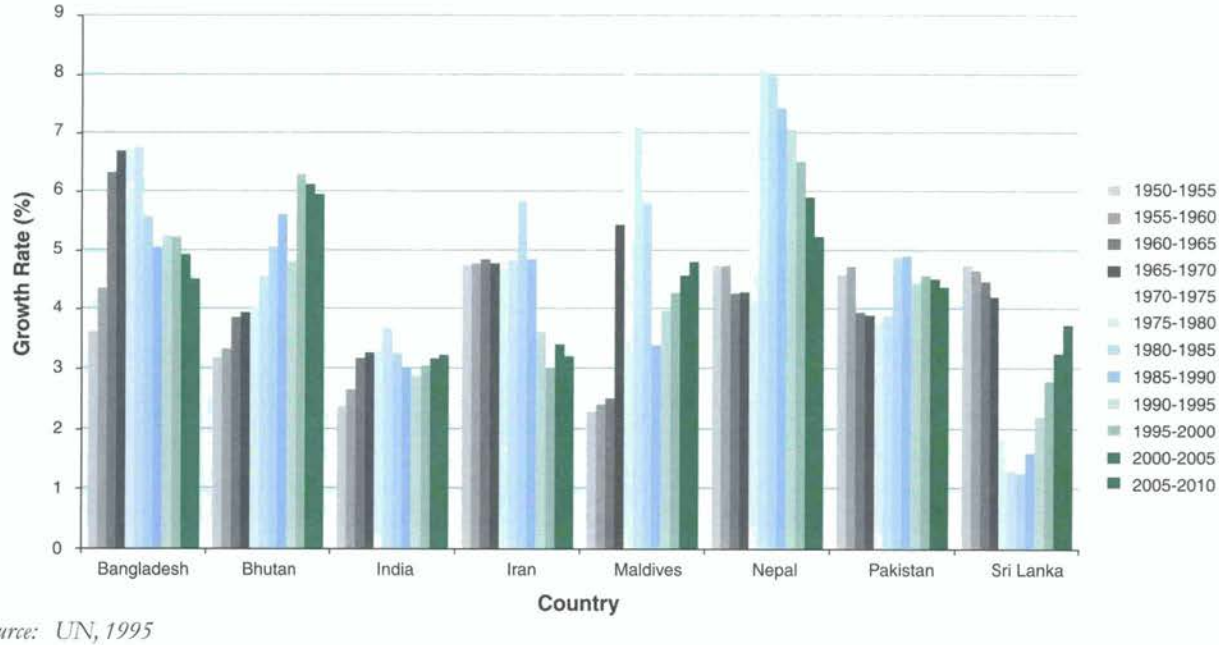
2.3 URBANIZATION

2.3.1 *Developments over the past 100 years*

The percentage of total population in urban areas has historically been lower in Asia than the rest of the world and still remains lower than that of developed countries. In 1965, with the exception of Japan, only 20 percent of Asians lived in urban areas, increasing to 35 percent in 1990. This is significantly less than the seven out of ten persons living in urban areas in North America, Europe and Latin America (ADB 1997). However, with rapid economic development and high rates of rural-urban migration, particularly in the last thirty years, urban populations in Asia have rapidly increased with a distinct trend towards urban primacy, i.e. most of the urban populations are concentrated in a few large cities. The impacts of rapid urbanization include encroachment of agricultural and forest lands, urban air and water pollution (and associated diseases), scarcity of safe drinking water, increasing traffic congestion and significant increases in solid municipal and industrial wastes.

In South Asia, the urban population increased significantly over the last fifty years (see Figure 2.3). In 1950, only two cities (Bombay and Calcutta) in the sub-region were among the thirty largest cities of the world. By 1990, six cities (Bombay, Calcutta, Karachi, Delhi, Dhaka and Tehran) were included in this category. Calcutta's population grew from 4.4 million in 1950 to nearly 12 million in the 1990s.

Figure 2.3: The Urban Population Growth Rate in Some Selected Countries of South Asia since the 1950s



Source: UN, 1995

In Southeast Asia, in 1960, only about 15 percent of the population lived in urban areas - less than the overall average of 17 percent for developing countries. During 1960-70, urban population increased by about 5 percent. From 1970 to 1990, rapid economic growth induced people to move to urban areas at a rate of 4 percent per year compared to the population growth rate of less than 2.3 percent over the same period. During the early stages of rapid urbanization, particularly in the 1980s, the capital cities were the main targets of rural-urban migration, resulting in increasingly serious environmental consequences (ASEAN, 1997). Some cities grew at a phenomenal speed: Jakarta grew to 8 million residents in 15 years, one-tenth the time it took New York City to reach the same population (ESCAP 1995).

In East Asia, China was one of the first countries to establish large cities, first with coastal cities in the 1920s and 30s, and later with industrial cities in Northeast China. From the 1950s on, urban populations and industry grew significantly throughout East Asia. In Japan, more than half (50.3 percent) of the country's total population already lived in urban areas by 1950, increasing to 77 percent in 1990. In Mongolia, the urban population grew from 21 percent in 1956 to 54 percent by 1994, with 27.5 percent of the Mongolian population concentrated in the capital city, Ulaanbaatar (State Statistical Office of Mongolia. 1996). The most phenomenal increase in city dwellers occurred in Korea DPR after the end of the Korean War (1950-53), when the urban population increased from 17.7 percent in 1953 to 59.6 percent in 1987 (Kantaiheiyo et. al, 1993), expanding most rapidly between 1953 and 1960, when it grew between 12 percent and 20 percent annually (IDE, 1994). In Seoul, the population increased 10-fold between 1950 and 1990. Since 1970, urban areas in Japan, notably Tokyo and Osaka, increased significantly as a result of rapid economic growth and rural-urban migration - to such a degree that the resulting population imbalance caused other serious social problems such as lack of agricultural labor in rural areas, and lack of land and housing in urban areas. In China, urban environmental problems began to emerge at the end of the 1960s and were aggravated in the 1970s and 1980s when the rate of industrialization and the number of cities greatly increased.

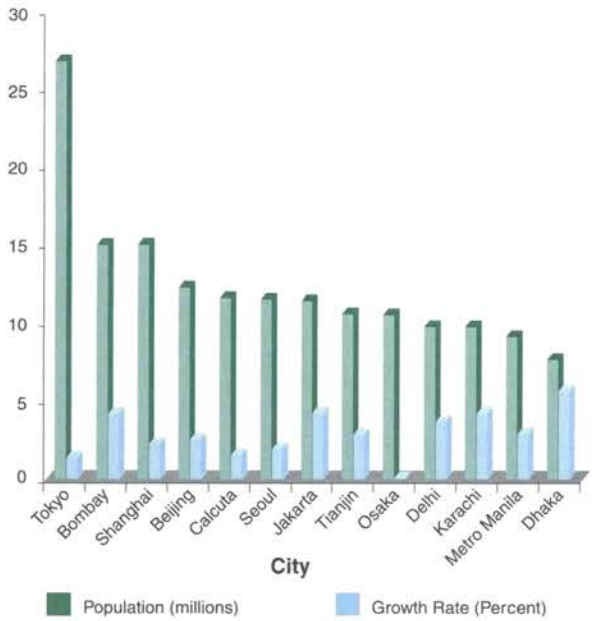
Although Australia's largest settlements occupy less than one percent of the nation's land area, they have a considerable influence on the natural environment of their hinterlands. In 1911, 57 percent of Australians lived in urban areas. Since then, this proportion rose steadily and now more than 86percent lives in urban areas (Commonwealth of Australia, 1998a). In the 1940s, Australia's big cities had an occupancy rate of 3.9 people per dwelling. This declined to 2.6 in 1991. After World War II, immigration provided the major boost to growth in most Australian metropolitan settlements. Most of the growth in cities like Melbourne and Sydney since the mid 1980s has resulted from immigration. In the 1970s, Australian cities rapidly lost population in their old inner suburbs as settlements dispersed outwards. Although the population of the core, inner and middle sectors of major cities has remained fairly stable over the 1986-91 period, almost all metropolitan population growth has occurred in outer suburbs (Australia SoE, 1996). Waste levels have been increasing, both in total and per person, over the past few decades. Australia produces more municipal solid wastes than other industrial nations - 690 kg per person per year, compared with an OECD average of 490 kg, and the second highest in the OECD. However, some surveys indicate that the quantities of solid wastes received at some landfills declined in the early 1990s, coinciding with the economic recession (Australia GEO-2 Input, 1998).

Urban development and road building only began 160 years ago in New Zealand. Since the 1940s, urban development has been based on a high level of motor vehicle ownership. This has led to sprawling suburbs, congested main roads, and poorly patronized public transport services. When averaged over the past 25 years, the rate of urban expansion has been around 4 percent per year. In contrast to many of the world's urban areas, the geographical spread of New Zealand's towns and cities outpaces their population growth. Although the urban population has increased by only 30 percent since 1969, the area of land classed as urban has almost trebled (New Zealand GEO-2 Input, 1998).

2.3.2 Developments over the past 10 years

Asia's urban population numbered 1,197,970,000 persons in 1995 having grown at an average rate of 3.3 percent during the period 1990-1995, compared with just 0.8 percent growth in rural populations. Of the 369 cities in the world with more than 750,000 residents, 154 are in Asia (160 if the 6 cities in Oceania are included), compared to 79 in Europe, 64 in North America, 35 in Africa and 31 in South America. In 1994, nine of the world's 14 largest urban centers (mega-cities with over 10 million residents) were in the Asia-Pacific region, including the largest, Tokyo. Figure 2.4 shows the populations and growth rates for the 11 largest cities in Asia for 1990-1995. Five of these cities (Bombay, Calcutta, Karachi, Delhi and Dhaka) are in South Asia.

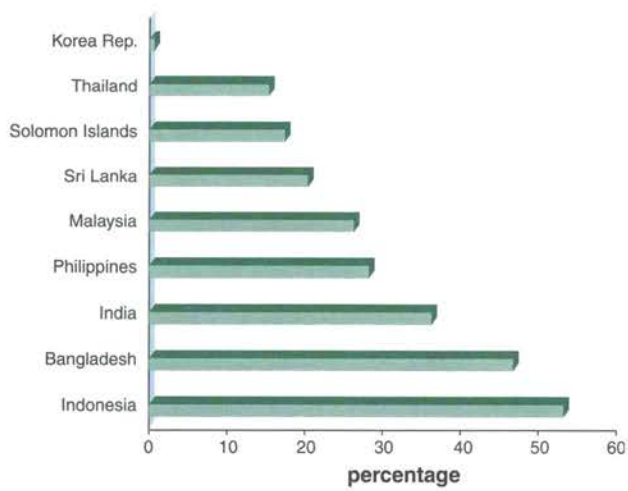
Figure 2.4: Asia's Largest Cities: Population and Growth Rates 1990-1995



Source: WRI 1996-97

Figure 2.5 shows that slums and squatters are growing within cities. In Colombo, for instance, as much as 50 percent of the population reside in slums and squatter areas (Sri Lanka, 1994). Although Colombo is severe in this regard, there are many countries worse off than Sri Lanka. Indonesia has over 50 percent and Bangladesh nearly 50 percent of urban populations in slum and squatter areas. The Republic of Korea is an exception with a remarkably low proportion of just about 1 percent (ESCAP 1993). The residents in slum areas are affected by indoor air pollution generated by biomass combustion and aggravated by poor ventilation and inefficient stoves.

Figure 2.5: The proportion of urban population residing in slum or squatter settlements in selected countries in the region



Source: WRI 1996-97

Throughout the region, urban air pollution is a significant problem, principally from fossil fuel combustion in the energy sector, industry and transport. In many large cities the number of vehicles is increasing rapidly. For example, car ownership in Seoul doubled between 1991 and 1992 (MoE, Korea, 1990 & 1995). Traffic congestion is also a serious problem, causing air pollution, delaying transportation, resulting in economic losses and affecting human health. Mongolia is one of the few countries in the region where traffic-congested zones cannot be found, even in urban areas, although the number of vehicles is increasing along with economic development (MNE, 1996d).

The total waste generated in the region amounts to 2.6 billion tonnes a year, of which solid waste accounts for 700 million tonnes and industrial activities generate 1.9 billion tonnes (ESCAP, 1995a). The East Asia sub-region generates the most municipal solid waste ranging from 327 million tonnes (46 percent of total Asia Pacific) in 1992 to projected 1,151 million tonnes (60 percent of total Asia Pacific) by 2010 (ESCAP, 1995).

In South Asia, urban growth rates ranged from 2.2 percent in Sri Lanka to 7.7 percent in Afghanistan. India and Pakistan, despite having relatively lower rates of growth (2.9 percent and 4.4 percent, respectively) have significantly large urban populations, and are home to the largest and fastest growing cities in the sub-region. Bombay and Karachi are growing at 4.2 percent per year, followed by Delhi at 3.8 percent per year. Throughout the sub-region, urban infrastructure has failed to keep pace with growing populations. Urban access to a clean water supply ranges from 66 percent in Nepal and 87 percent in Sri Lanka to 100 percent in Maldives and access to sanitation ranges from 62 percent in Pakistan and 89.6 percent in Bhutan to 100 percent in Maldives (ASEAN 1997, WRI 1996-97, Government of Maldives, 1998). The amount of urban wastes is increasing, and waste disposal systems are inadequate. For example, only around 40 percent of municipal waste is collected in Nepal (Nepal, 1994).

The rate of urbanization in ASEAN during the 1990s is expected to taper off to around 3.5 percent (ASEAN, 1997). The urban population is highly concentrated in the capital cities, partly as a result of intensive industrialization around these cities' favorable infrastructure. For example, in 1992, Thailand has more than 20 percent of factories concentrated in Bangkok,

and the population of Bangkok accounted for 34 percent of the total urban population of Thailand (NESDB 1992). A similar trend is true in other capital cities in the region, including Manila with 32 percent of the country's urban population, Kuala Lumpur with 22 percent and Jakarta with 16 percent (ASEAN, 1997). Domestic (especially urban) and industrial pollution are estimated to constitute more than two-thirds of total pollution generated. A large percentage of industrial wastes, including hazardous chemical wastes that may be carcinogenic or systemically toxic, are discharged without treatment. In Thailand, the effects of toxic and hazardous wastes on human health have been increasing since 1988, affecting not only the workers directly involved in handling these substances but also residents in areas near factories. Based on the rate of industrial expansion, hazardous and toxic wastes could increase at a rate of about 5 percent to 7 percent a year. A preliminary survey in 1985 indicated that industries in Malaysia generated about 200,000 tonnes of hazardous wastes while those in Thailand generated about 106,000 tonnes. Based on various estimates, hazardous wastes generated in individual ASEAN countries (not including Brunei Darussalam) could range from 500,000 to over one million tonnes per year. In recent years, however, almost all the ASEAN countries have instituted and/or upgraded legislation for the safe handling, treatment and disposal of toxic and hazardous substances (ASEAN, 1997). The industrial wastes have contaminated drinking water and led to problems such as diarrhea, dysentery and typhoid. Throughout the subregion, the percentage of urban population with access to safe drinking water ranges from 35 percent in Indonesia to 100 percent in Singapore and access to sanitation ranges from 79 percent in Philippines and Indonesia to 99 percent in Singapore (ASEAN, 1997; WRI 1996-97). Investment in domestic wastewater treatment systems has been accelerated in many Southeast Asian countries. In Malaysia, the government has privatized wastewater treatment systems in all urban areas of Peninsular Malaysia. In Bangkok, public investment in domestic wastewater treatment facilities has been accelerated and a wastewater management organization was established to facilitate the system.

In East Asia, the already significant urban population has grown considerably. In 1994 in Japan, about 49 percent of the total population was concentrated in just 14 percent of the total land area. In 1995 in Korea Rep., 81 percent of the total population lived in urban areas. Seoul contains almost one-fourth of the total population of the Republic of Korea. In Korea DPR, the total urban population increased from 31 percent in 1950 to 59.8 percent in 1990 and 61.3 percent in 1995, although the population of the capital, Pyongyang, remained at 17 percent between 1980 and 1995 (UN-World Urbanization Prospectus, 1995). In 1975, China's urban population stood at 160 million persons, rising to 359.5 million by 1996. In general, the sub-region has good level of services available to its residents, for instance in urban areas in Japan, 100 percent of the population has access to health care, safe water and sanitation (World Bank, 1997).

During the last decade, the volume of waste in Japan has been affected by the spread of consumer goods and the "throwaway principle" (EA, 1997). Since 1990 the economic downturn and implementation of recycling policies have led to some decrease in waste generation (EA, 1997 & OECD 1994). Waste volume in Korea Rep. has been steadily growing, particularly industrial waste which increased by about 35 percent in volume between 1988 and 1992 (from 51,230 tonnes/day to 69,439 tonnes/day) (Korea Rep., 1998). In China, the urban population increased rapidly from 26.4 percent to 29.4 percent (301.9 million to 359.5 million) between 1990 and 1996. More than 300 cities have experienced water shortages, including more than 100 cities with daily shortages of 10 million cubic metres (SPC, China, 1995). In some cities, urban underground water is over-exploited and there are serious cases of urban land sink and seawater intrusion. Only 20 percent of urban sewage receives concentrated treatment and less than half (around 45.4 percent) of urban garbage is disposed of in an environmentally sound manner (SSB, China, 1997). In 87 cities, in 1996, the yearly average of suspended particles was 55-732 $\mu g/m^3$ and in some cities, such as Guangzhou, air pollution caused by soot and smoke was running parallel with that caused by automobile emissions (SEPA-China). In China, also in 1996, the yearly average of So_2 and No_x levels were 2-404 $\mu g/m^3$ and 12-129 $\mu g/m^3$ respectively (SEPA-China). Increasing urban noise levels have also added to urban pollution and are now considered to be one of the three major problems.

The rapid development of Australia's urban centers along eastern, southern and southwestern coasts is destroying and degrading ecologically sensitive coastal habitats. Large cities, notably Sydney, are experiencing "capacity" problems associated with photochemical smog, stormwater, wastewater and transport infrastructure (Commonwealth of Australia, 1996). In Australia, total and per capita waste production levels have been increasing over the past few decades. There is some evidence that increases in waste generation have been at least partially offset by increased recycling. Unfortunately, the data upon which these trends are based are subject to considerable uncertainty because Australian jurisdictions have previously used inconsistent

terminology and classification of waste streams and their components (OECD, 1998). Many smaller rural towns have declining populations and are generally experiencing the impacts of declining rural industries, particularly in wool and beef. As a consequence of their limited growth potential, these towns sometimes have neither adequate technological investment nor sufficient social and economic infrastructure to address environmental and other problems. Over 18 percent of the Australia's indigenous population of around 270,000 lives in remote settlements. Many aboriginal communities face critical problems of poor health (death rates among aboriginal people is between two and four times those of the Australian population) and high unemployment levels (aboriginal rates are about four times higher than the national unemployment rate of between 8 percent and 10 percent). Remote communities also have limited access to good quality drinking water (Commonwealth of Australia, 1996). The two main distinguishing characteristics of Australia's settlement pattern are the spread of urbanization along the coastline and the concentration of Australia's population in five large cities. The internationalization of the Australian economy is increasing the competition between the major capital cities on their ability to provide goods and services for the national or international market places. In 1993, 70 percent of Australia's population lived in the urban agglomerations. At present, approximately 86 percent of the population lives in urban areas (Commonwealth of Australia, 1998a). They accounted for nearly three-quarters of Australia's population growth between 1986 and 1993. Australia's five largest cities consumed 160,000 hectares of rural land as a consequence of the tentacles of urban growth in those seven years. All urban centers in Australia with population of more than 500,000 are located on the coastal fringe of the continent, including Sydney, Melbourne, Brisbane, Adelaide and Perth, and discharge most of their effluents to the ocean or tidal estuaries. Each year around 10,000 tonnes of phosphorus and 100,000 tonnes of nitrogen are discharged to the near-ocean environment. The number of registered vehicles per thousand persons has been also increasing steadily from 540 in 1982 to 606 in 1995 or a total of about 11 million vehicles. The total distance traveled by all motor vehicles in Australia in a 1995 period represented an increase of 11 percent from the same period in 1991 (Commonwealth of Australia, 1998a).

Although New Zealand's urban areas are generally safe and well serviced, an increasing number of environmental and social problems are becoming evident. All urban areas have sewerage systems, stormwater drainage systems, piped water supplies and waste disposal services, but in recent years these have come under strain in some areas. As demand for water has grown, Auckland, Christchurch and several other cities have had to introduce summertime water use restrictions during El Niño events. Traffic congestion on major urban routes and in city centers is an increasing problem, and is associated with increasing carbon monoxide pollution in the busier traffic corridors. Because many urban areas are located on floodplains and estuaries, urban expansion has been at the expense of some of the nation's wetlands and more fertile soils. Urban areas are also sources of vast amounts of wastes and many of the country's estimated 7,800 contaminated sites are in urban industrial areas.

2.4 ENVIRONMENTAL GOVERNANCE

Environmental governance encompasses issues of protection of human health and environment, public participation in decision making and securing natural resource base. It provides a mechanism and condition in the country that enables integration of environmental concerns in pursuit of development. Effective governance also addresses the issues of information sharing, transparency and accountability. In the Asia-Pacific region, most of the countries have created a mechanism and condition for environmental governance through formulating environmental laws, and setting up of ministries and agencies to implement the laws. But, there has been varying degree of success on effectiveness of environmental governance across the countries in the region to protect environment, natural resources and human health. There have been several hindrances and pitfalls in the existing approach of governance. However, experience gained over the past decades would certainly be the driving forces towards achieving the goal of environmentally sound development.

Experience in the last 25 years, since the Stockholm Conference, reveals the fact that environment sector has been under-funded and under-staffed. Although environmental laws exist, for example, in restricting the right of industries to exploit natural resources and use local sinks for wastes, they are often not implemented for many reasons, and the environment continues to deteriorate at a rapid rate. Rules on environmental protection are often bent or ignored due to insufficient funds, equipment and/or skilled personnel; and lack of know-how, adequate institutional structure and mechanisms, and political will. Legislators need to recognize and reflect upon these problems. The passing of laws is not enough to ensure environmental

protection, health and safety. Political commitment and public support are needed to enforce the laws, to implement policies set forth to meet goals, and for people and organisations to comply with the law.

An alternative view sees the law as a tool of understanding by which human society regulates itself. It is argued that voluntary compliance is more socially desirable than forced compliance, and that the ideal mode of law enforcement is where the law does not need to be enforced (Oposa, 1996). In this regard, the general public's awareness, understanding and appreciation of the law and the right to participate in the decision-making processes are essential. They are essential because the general public is those who contribute to and are affected by environmental degradation, and are also those who promote the law through implementation and compliance. However, absolute voluntary compliance is probably not yet possible because society, in general, continues to regard environmental protection as secondary to economic growth and therefore needs some form of enforcement to ensure that the doers of environmental degradation are punished and the victims of such actions are compensated. However, incentives to encourage voluntary compliance, such as, public education in legal affairs, adopting the polluters pay principle, financial support for building capacity at all levels and sectors, and political support for the development of environmental non-governmental organisations, are all crucial for the effective implementation of environmental legislations.

The experience of Thailand, China, India and Papua New Guinea in environmental governance is illustrated through case studies. The objectives of the case studies are three-fold: (a) to examine the role of law in harmonizing the national and regional development with its environmental imperatives; (b) to find the extent to which the existing legal system can safeguard the environment and protect the rights of citizens in the Asia-Pacific region; and (c) to see how the legal system can provide the mechanisms that protect the environment and people's livelihood. The legal case studies include: the Phoenix Pulp & Paper factory polluting the Nampong River in Thailand; the Three Gorges Dam on the Yangtze River in China; the leather tanneries polluting the Ganges River in India; and the Ok Tedi Mine polluting the Ok Tedi River and the Fly River in Papua New Guinea.

2.4.1 *Thailand*

The basis for environmental law in Thailand is found in the Constitution of the Kingdom of Thailand B.E. 2534 (1991). Article 74 states that "the State shall conserve the environment, balance the use of natural resources and their replacement, eliminate and prevent pollution, and plan for the use of land and water" (Baker & McKenzie, 1993). Based on the stated fundamental framework, the Enhancement and Conservation of National Environment Quality Act of B.E. 2535 (hereafter called the 1992 Environment Act) was enacted repealing the previous versions of 1975, 1978 and 1979, with the intent of improving the effectiveness of the enforcement of environmental law (TEI, 1997). Together with this Act, other environment-related laws were also amended or enacted in 1992, namely, the new Factory Act, the Hazardous Substances Act, the Energy Conservation Promotion Act, the new Public Health Act and the revised Cleanliness and Orderliness of the Country Act. In all, there are approximately 70 to 80 regulations directly and indirectly related to environmental matters (TEI, 1997).

The most significant and comprehensive law is the 1992 Environmental Act. The new features that are different from the previous Environment Acts include (TEI, 1995: 1-2):

- Empowering the National Environment Board (NEB) to make decisions regarding national environmental issues, such as, the prescription of environmental quality standards and sanctions. The NEB was originally created under a 1975 legislation with largely advisory functions. Under the new law, the NEB is a ministerial-level Board chaired by the Prime Minister with the Permanent Secretary of the Ministry of Science, Technology and Environment (MOSTE) as secretary to the Board (TEI, 1997).
- Restructuring the governmental offices in charge of environmental protection by replacing the Office of the Board of Environment with the Office of Environmental Policy and Planning (OEPP), the Pollution Control Department (PCD) and the Environmental Quality Promotion Department (EQPD), all of which are under MOSTE. The PCD of MOSTE is responsible for enforcing standards and sanctions prescribed by the NEB (Baker & McKenzie, 1993).
- Delegating the environmental protection authority from the above three departments at the national to the provincial level.
- Designating certain areas as Environmental Protection Zones (EPZ) and/or Pollution Controlled Zones (PCZ).
- Requiring the provinces with EPZ to submit an Action Plan for Provincial Environment

Protection. Other provinces may submit an Action Plan if they so desire.

- Establishing an Environmental Fund chaired by the Minister of MOSTE.
- Increasing the type of projects or activities requiring an Environmental Impact Assessment (Nicro, et. al., 1997). Since the establishment of the National Environmental Quality Act of 1978, NEB has implemented a "selective projects" approach identifying environmental impacts along with mitigation measures and monitoring programmes for certain types of projects.
- Recognizing the importance of public participation. Section 6 of the 1992 Environment Act states that individual persons have the rights and duties to "petition or lodge a complaint against the violator, where the petitioner is a witness to any act committed in violation or infringement of the laws relating to pollution control or conservation of natural resources ... cooperate and assist government officials in the performance of duties relating to the enhancement and conservation of environmental quality."

Public participation is strengthened by the new charter, which has been enforced since October 11, 1997. It has provided Thais with rights and a mandate unprecedented in any other constitution. One section states that: "A person holds the right to take part with the state and his/her community in maintaining and exploiting the country's natural resources and biodiversity. They also have the right to protect, promote and preserve the environment which is part of their normal and continuous way of life. They can take action to ensure that the environment they are living in is not dangerous to their health, welfare and quality of life." However, there are no current national policies mandating the incorporation of public participation in the environmental impact assessment process per se. There is, however, limited legal basis for the incorporation of public opinion in development project management. But, the critical point is that, currently, no law or regulation requires that opinions and concerns expressed by the public during the participation process must be given weight during the decision-making process.

Although there is now a comprehensive law to protect the environment, this does not mean that implementation is fully effective. The extent to which environmental legislation is translated into meaningful action to protect the rights of the citizens will be illustrated in the Nampong River case study.

The Nampong River case study

The Nampong River runs through Khon Kaen Province that has been developed as the regional center of the Northeast and has became one of the country's favorite areas for investment. The construction of the Ubonratana Dam, in the late 1960s, on the Nampong River, has not only increased Khon Kaen's electricity generation capacity but has also provided water-poor Khon Kaen with most of its water supply. Until recently, the water has been used mainly for power generation and irrigation, but currently it has been increasingly used for industry. Figure 2.6 shows the map of the Nampong river and the location of major industrial plants. Along the middle course of the Nampong River there are several factories including sugar mills, pulp and paper mills, thermal electricity cogenerating plants, breweries and starch processing plants. These factories make use of the river not only as a source of water for their production but also as a sink for their effluents. Since the 1980s the river has experienced episodes of pollution, strong odors and fish kills. However, the problems have remained sporadic and limited, affecting only the local residents. It was not until the 1990s when the environmental damage to the Nampong River received national attention from the media and the wider public, as a result of rising environmental consciousness among the public and the enactment of the 1992 Environment Act.

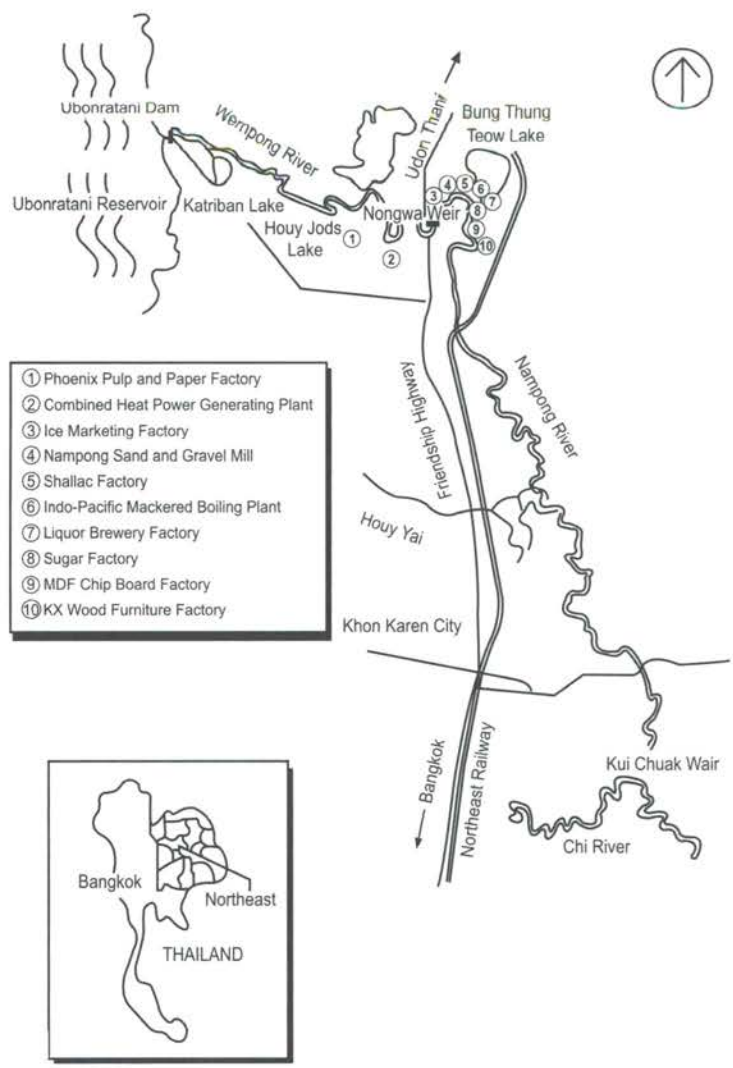
In May 1993, the Phoenix Pulp and Paper factory was accused of polluting Nampong River by discharging effluents that were not adequately treated. Villagers reported that the company was not operating the wastewater treatment facilities all the time to reduce production costs and operated them only during inspections by government agencies. Furthermore, the Pasteur Institute in Lyons, France, discovered that sludge from the Phoenix factory contained as much as 4 micrograms/liter of dioxin, possibly from chlorine-based bleaching of pulp. Dioxin is known as a carcinogen, thus, raising fear among the people in Khon Kaen (Prapertchob, 1997). To confirm this finding, sludge samples from the Phoenix factory were sent to other laboratories by different research teams, but the outcomes were inconsistent. No punitive action could therefore be taken. This monitoring problem was brought about by the lack of a standardized monitoring system, resulting in different testing methods and varying results. Thus while a law existed for this purpose, it could not be properly enforced due to limitations in the technical and procedural aspects.

In addition, it was not clear which organization was directly responsible for environmental monitoring. Several government offices claimed that they were the appropriate body to handle the case. On the other hand, the people's movements insisted that monitoring required the participation of the local people, since they were the actual victims of environmental pollution. The problem was that they could not conduct the survey themselves because they needed to be trained to a certain level of competence to enable them to follow procedures and understand the process. But it was not only the monitoring system that was unclear, the effluent standards for pulp and paper factories were also vague. For example, two different government agencies were enforcing two different standards for biochemical oxygen demand (BOD). OEPP stated that the BOD should not exceed 60 mg per liter but the Industrial Works Department allowed up to 100 mg per liter (Prapertchob, 1997).

When Phoenix requested permission to open a second mill in 1994, the Office of Environmental Policy and Planning required an environmental impact assessment (EIA). Permission was granted when the pulp mill signed an agreement stating that by July 1996, it would no longer discharge wastewater and would find some productive use for it. However, it was learned that the company could not meet the requirements set by the EIA (Bangkok Post, 29/09/96).

In line with the EIA, "Project Green" was devised. It involved using the mill's treated wastewater to irrigate eucalyptus plantations. By December 31, 1994, 22,021 rai were under cultivation, under Project Green. But in 1996, Bangkok Post, Thailand's English-language newspaper, reported several incidents where villagers had complained about the wastewater overflowing into the adjacent low lying paddy land, causing damage to rice production. Trace elements from the wastewater

Figure 2.6: Map of the Nampong River and Location of Major Industrial Plants



Source: Prapertchob, 1997

also contaminated the soil and water supply. They discovered this only after their crops were destroyed and their water supply contaminated. During that time, studies at Maha Sarakham University showed that at least 7 percent of the treated water irrigating the eucalyptus fields had overflown to adjoining land (Bangkok Post, 29/09/96). Although some local people, farmers, scientists or engineers in the area might have suspected the consequences of Project Green, it was difficult to prove in court that indeed environmental damages had resulted from the project.

In May-June 1995, about 700 people from nine villages went to the Deputy Governor of Khon Kaen Province to seek help and ask for compensation from the Phoenix factory for the damage caused by the wastewater from the Green Project that had overflown into their rice paddy fields. The villagers demanded payment of more than 5 million baht (US$200,000) to cover the damage to over 1,200 rai (19.2 hectares) with an initial payment of about 2.8 million baht (US$112,000). In the end, Phoenix agreed to pay the compensation in an out-of-court settlement and pledged to solve the pollution problems (Prapertchob, 1997).

This case demonstrates that the private sector is not unwilling to protect the environment and support the local community. Moreover, since the establishment of the company, it has instituted welfare schemes for both its workers and the surrounding villages. For its workers, it has provided housing, transportation, education for their children and healthcare. To the local communities, it has implemented community development projects such as providing water supply to two nearby villages, offering free medical examinations to villagers and supporting village tidiness and beautification projects (Prapertchob, 1997).

Project Green reveals that environmental consequences may not be easily predicted and, at the same time, not carefully considered. The lack of consultation with environment experts and the local community may be the core of the problem. However, it is important to recognize that people's participation is not a panacea to environmental protection. As mentioned in Thailand Environment Institute's 1995 Annual Conference: "The majority is not always right, particularly in a case where technical expertise is involved. Nonetheless, people's participation is a mechanism by which the most accurate conditions of an environmental problem in each location can be reflected, as environmental problems are to a great degree contextual in time, space and taste of people." (TEI, 1995: 12) However, by involving people's participation, decisions will be more accurately based on the better use of resources and the sentiments of the various actors involved.

The Nampong River case emphasizes the need to adequately address institutional and legal concerns, the human resources and technical concerns, and the informational concerns. Overlapping responsibilities of various agencies and vague standards and guidelines can create problems and attempts should be made to address this issue adequately. At the same time, environmental legislation should insist on stakeholder cooperation to establish clear standards and a comprehensive monitoring system. The case also clearly illustrates the need to upgrade environmental expertise among the many sectors involved. For instance, a university-industry linkage on environmental monitoring and clean technology should be encouraged. Environmental law should provide a framework for the empowerment and capacity building of local communities so that they may be equipped with the appropriate tools to effectively monitor the environment and help make informed decisions.

The difficulty of proving the source and cause of damage and any potential damage prior to the initiation of a project are problems clearly illustrated in the Nampong River case study. These problems stress the importance of awareness-building and the education of the judicial court on environmental issues and the difficulty of providing proof in environmental litigations. The case also highlights the importance of scientific evidence from a legitimate institution in proving environmental damage and predicting potential environmental damage. To help address these problems, environmental law could mandate the establishment of research laboratories and environmental institutions that could assist the judicial courts in the technical aspects of environmental issues.

2.4.2 *People's Republic of China*

China's initial attempt to seriously tackle environmental problems at the policy level began with the First National Environmental Protection Congress held in 1973, in response to the 1972 Stockholm Conference. After the 1973 Congress, the State Environmental Protection Commission was established to formulate environmental policy for China. However, through the 1970s, the country was preoccupied with internal political conflict and this obstructed progress in environmental policymaking (Kojima, 1997). It was not until the early 1980s when the Chinese government began to incorporate environmental protection into state policy. PRC's Sixth Five-Year Plan for Economic

and Social Development, declared in 1982, embodied the aim of environmentally conscientious growth. The plan made environmental protection a part of the process of economic development (Kojima, 1997; Profaizer, 1993).

China's commitment to environmental protection led to the establishment of the 1989 Environmental Protection Law of the People's Republic of China at the Third National Environmental Protection Congress. This is probably China's most significant piece of legislation in environmental protection. Under Article 5, the Law requires that "while formulating national economic development plans, overall arrangements [shall] be made to protect the environment" (1989 Environment Protection Law cited in Profaizer, 1993: 330). The law has given the government the power to "criticize, give warnings to, or assess fines [against]" polluters who "harm the environment and endanger people's health" (1989 Environment Protection Law cited in Profaizer, 1993). There is now a complex set of environmental legislations and standards enforced by a large group of officials. There are approximately 300,000 full-time environmental officials throughout China at both the central and local levels (CER, 1997). However, since many enterprises remain state-owned, there is a very close linkage between the government and industry which may undermine the government's commitment to environmental protection, especially if economic development is pursued at all cost.

Theoretically, there should be communication between the various government ministries, agencies and Bureaus on environmental issues through the coordination of the cross-ministerial State Environmental Protection Commission. All government bodies are under the State Council, China's highest administrative and executive body. Despite this fact, local governments are self-funded, and depending on the region, this may mean a higher degree of political autonomy and differing goals. With respect to the rising profile of environmental issues in the PRC, most government bodies have become interested and involved in environmental policy from the viewpoint of their particular jurisdiction. In practice, there are overlapping layers of local government control (provincial, municipal, county, towns and villages) that are responsible for the enforcement and implementation of environmental policy.

In 1988, the National Environmental Protection Agency (NEPA) was formed as the secretariat of the State Environmental Protection Commission. NEPA now acts as advisor to the State Council on environmental policy, sets environmental standards, monitors the environment and enforces environmental policies through a network of locally affiliated environmental protection offices in China. NEPA has about 2,000 staff members and an annual budget of about 20 million yuan (US$2.5 million). This compares poorly with the UK's Environment Agency with 9,000 staff members and a budget of about US$900 million, covering a country 20 times less populous than China (CER, 1997).

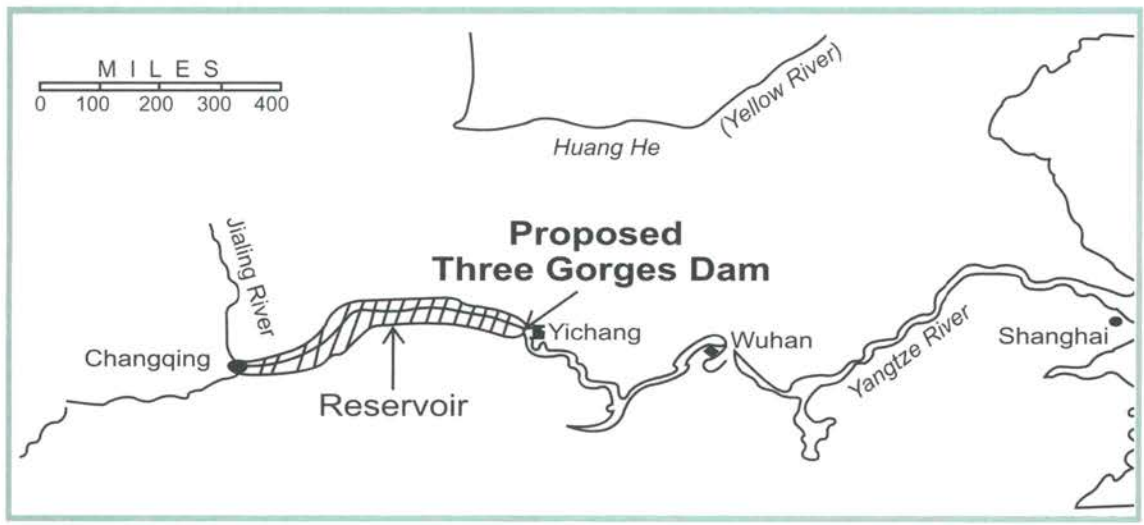
The Three Gorges Dam case study

The Three Gorges Dam Project (TGDP) on the Yangtze River is the world's largest hydroelectric scheme. The Yangtze River is the third largest river in the world, spanning a length of 6,300 kilometres. (Refer Figure 2.7). The construction of the dam is along a 240-kilometre stretch in the upper course of the river, from Chongqing to Wuhan, at the Xiling, Wu and Qutang Gorges (known as the Three Gorges) (Wakabayashi, 1997; Tiyaamoirnwong, 1997). This mega-dam project will require technology of unprecedented sophistication. It will include 26 turbines, each capable of generating 680 megawatts of electricity, and the world's highest vertical shiplift. The dam will be 185 metres high with a reservoir 600 km long, 39.3 billion cubic metres in volume near the dam, near Yichang, and the industrial city of Chongqing (O'Neill, 1997a; Saran, 1998).

The idea of damming the Yangtze River was first envisioned more than 70 years ago by Sun Yat Sen, founder of the Chinese Republic. For those 70 years, there had been controversy about building, as well as financing the construction of such a dam. However, in 1992, the Seventh National People's Congress approved, by an approximately two-thirds majority, a resolution to construct the dam. The construction commenced in 1994 and it is expected to be completed by 2009 (Wakabayashi, 1997). "The Three Gorges Project," Premier Li Peng has claimed, "will show the rest of the world that the Chinese people have high inspirations and the capabilities to successfully build the world's largest conservancy and hydroelectric power project." (cited in Daiwo, undated). To China, the dam is an expression of national pride, offering proof that China has joined the ranks of the world's developed nations - one that is capable of building the world's biggest dam, taming the world's third mightiest river and harnessing its strength to provide the electricity needed to fuel China's economic growth and modernization.

Officials supporting the project argue that the TGDP can (O'Neill, 1997b; China Report, undated):

Figure 2.7: Map of the Area of the Proposed Three Gorges Dam



(Source: IRN, 1997)

- satisfy China's growing demand for electrical power. It is predicted that, upon completion, the TGDP will generate 18,200 megawatts of electricity, approximately 9 percent of China's current total power output. The 26 hydroelectric turbine units will be able to produce more energy than fifteen nuclear power stations, or have the annual output equivalent to burning 50 million tonnes of coal without the corresponding air pollution. It is estimated that the TGDP will prevent the emission of 100 million tonnes of carbon dioxide, 10,000 tonnes of carbon monoxide, 2 million tonnes of acid rain causing sulfur dioxide, 370,000 tonnes of nitrogen oxides and huge amounts of fly ash. The costs and effects of nuclear waste disposal and coal mining will also be avoided.
- end severe flooding of the Yangtze River. In one of the most serious cases, in 1954, more than 30,000 people were drowned and 3.17 million hectares of land inundated.
- improve navigation on the upper reaches of the river, thus, making communication and transportation of goods much less constrained. It will also make the major industrial city of Chongqing accessible to ocean going ships.
- act as an engine of growth to the region surrounding the actual dam, a region which has been lagging behind the east coast region (the Special Economic Zones) in economic development.

However, critics of the TGDP have raised important questions related to the environmental impacts, basic rights to information, freedom of expression, and China's bureaucracy. Critics claim that the project will permanently submerge approximately 30,000 hectares of arable land (this at a time when scientists are concerned with China's increasing reliance on food imports), 1,500 factories, at least 160 towns and 16 archeological sites, and force the resettlement of over 1.9 million people (Ex-Im Bank, undated; Saran, 1998). Other potential environmental impacts include (Soundnet, 1997):

- coastal erosion caused by the sediments that the Yangtze River transports to the coastline being trapped behind the dam;
- extinction of animal and plant species, some unique to the region such as the Siberian White Crane and the Yangtze River dolphin; and
- water degradation since the dam may slow the flow of the river water, causing pollution from industrial and residential sources to concentrate in the river rather than being flushed out to sea.

The issue of providing evidence to support or reject a project is a crucial matter. It is difficult to predict the exact outcome of the project and prove that the perceived problems and benefits would indeed occur after project completion. Assessment is often based on previous experiences and environmental data can often be presented and interpreted in different ways to support one's argument. For example, opponents

of the TGDP claim that the dam's capacity to generate electricity depends on how effectively the accumulation of sediments behind the dam can be avoided. They point to the Three Gate Gorge dam on the Yellow River as an example. It has been identified to have triggered floods and caused the displacement of more than 400,000 people. It now produces less than one-third of the power that was initially estimated. Its turbines have been damaged by sediments and it has not been able to effectively fulfill its flood control functions (Soundnet, 1997). In another case, the sluice gates of the Banqiao Dam were blocked by sediments and could not be opened. This dam collapsed in 1975 killing an estimated 86,000 to 230,000 people (Tiyaamornwong, 1997).

On the other hand, proponents of the TGDP argue that accumulation of sediments can be easily avoided by letting rainy season silt-laden waters flow through the dam. They also cite recent scientific reports indicating that the Aswan Dam, often given as an example of poor sediment management, is releasing more sediments out of the river than scientists thought at first (U.S. Embassy Beijing, 1996).

Another serious problem is the shortage of natural science and social science professionals and technicians needed to adequately assess the environmental and social impacts of the project. In 1982, the average number of engineering technicians per 10,000 people in the whole of China was 23.3, and in the TGDP region, only 4.12. Many of the technical expertise had been sourced from abroad (Daiwo, undated). Accordingly, this could jeopardize the sustainability of the project when it is completed due to lack of proper skills and capabilities to operate and maintain the dam.

In 1993, seven American non-governmental environment organizations filed a lawsuit against the U.S. Bureau of Reclamation and the Army Corps of Engineers - government agencies that had been acting as consultants to the TGDP since the 1940s. The suit charged that such assistance violated U.S. laws because the reservoir would flood the habitats of a dozen endangered species. In the late 1993, the U.S. Bureau of Reclamation withdrew from the project. With the project's budget escalating to five to six times more than what was expected in 1992 (US$11 billion), there is now a growing demand for foreign assistance. Some non-governmental organizations opposed to mega-dam projects believe that efforts to halt construction of the TGDP should be attempted by stopping governmental agencies and private corporations abroad from becoming involved in the project. Accordingly, about 120 German non-governmental organizations are now pressuring banks in Germany to withdraw their support for the TGDP (IRN, 1997).

The TGDP, like many other projects, is a technical issue as well as a political one. The feasibility and desirability of the TGDP should be viewed in terms of the historical meaning and symbolism of the Three Gorges idea. Some believe that the TGDP is a representation of the modernization of China. To many government officials in China, it is a symbol of national pride. Nevertheless, from a humanitarian viewpoint, the project should not be implemented at the expense of the lives of the Chinese people. Furthermore, if the project should fail, this could even hinder the development of China's economy and hurt China's national pride. Critics of the project charge that the general public is not given adequate information about its technical, social and environmental risks and that there has been no public consultation or public debate regarding the process of the dam construction (Soundnet, 1997).

A feasibility study on the TGDP was carried out but it involved only the concerned government officials and technical staff. The Ministry of Water Resources and Electric Power, the Yangtze Valley Planning office and the Preparatory Office of the Three Gorges Project Development Corporation were appointed to carry out this study. The differing views were collected and edited and a seven-volume report was published. The views either proposing or opposing the TGDP, de jure, were equally weighted and enjoyed equal opportunity of expression. However, critics believe that the decision-making process was de facto a closed one that grossly distorted technical data in favor of dam construction. Environmentalists in China and abroad criticize the Communist Party for ignoring the environmental and social impacts of the TGDP. They charge that the experts were largely supporters of the pro-dam leaders and that well-known dam opponents in the environmental and scientific communities were excluded from these consultative groups (Daiwo, undated).

Article 8 of the Environmental Protection Law briefly mentions the rights of citizens (Profaizer, 1993). Public consultation is a requirement in any feasibility study. One of the 14 criteria for successful human resettlement states that "the resettlement plans should have broad-based popular acceptance and the affected population should be consulted." However, critics claim that the study provides no evidence that the local populations have had any legitimate input to project planning and decision making. In fact the report states that "the expectations and concerns of the host population are not so well known" suggesting that the

host population may not have been consulted at all (Daiwo, undated).

In response to international pressure, China has initiated projects to minimise environmental degradation. For example, Chongqing city, in cooperation with Denmark, is currently building a wastewater treatment plant with a daily processing capacity of 48,000 tonnes. China is also developing processing and discharging techniques and recycling standards for factories. The objective is to have no untreated industrial and domestic wastewater discharged by the time the TGDP is completed (China Embassy, undated). However, the full impact of the TGDP on China's environment, economy and people still remains to be seen. China has set up the Three Gorges Project Ecological and Environmental Protection Coordination Group composed of 16 government departments and localities to supervise and push forward the environmental protection programme (Chinese Embassy, undated). Although there has been an appreciation of the magnitude of the potential pollution problems and the effects they may have on health and economic development, positive actions remain difficult. And a serious obstacle has been the overlapping layers of local government control and responsibility.

As in the earlier case study, the Three Gorges Dam Project has raised institutional and legal concerns, human resources and technical concerns, and informational concerns. Among the important institutional and legal concerns are the marginalization of environmental issues at all sectors and levels and the lack of a comprehensive framework with a clear delineation of responsibilities and a clear set of standards to be followed. Accordingly, environmental laws should be formulated in such a way as to promote the mainstreaming of the environment into economic and social development policy and planning. The law should mandate stakeholder participation in the policy planning and implementing processes of projects and programmes with the aim to increase project effectiveness and accountability.

A major human resources and technical concern, on the other hand, is the shortage of local technical expertise to assess the environmental and social impacts of the project and to operate and maintain the project. Thus financial resources should be directed towards the education and capacity building of the local people on environmental issues. A main informational concern is the difficulty of forecasting the outcome and impact of the project on the people and the environment. To overcome this problem, one of the legislative roles should be to promote public participation to ensure that the people are informed of the progress of the project and are able to participate in deciding the development path for their region. Thus it should be legally required that relevant information on matters that have significant impacts on the people's well-being be made accessible to the public.

2.4.3 India

The Stockholm Conference of 1972 gave India the initial impetus to develop its environmental policy and legislation. In the 42nd Amendment to the Constitution, Article 40-A was added: "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country." (cited in Khan, 1994:13) Although this provision was not legally binding, it was fundamental to the governance of the country. The Conference and the Constitution pressed the Parliament of India to initiate legislation to combat environmental degradation and improve the deteriorated environment. The specific laws adopted in the post-Stockholm period to deal with various aspects of environmental pollution consisted of the Water (Prevention and Control of Pollution) Act 1974 (hereafter the Water Act) and the Air (Prevention and Control of Pollution) Act 1981 (hereafter the Air Act) (Khan, 1994).

Despite India's commitment to environmental protection, pollution persisted. The Bhopal disaster in 1984 led to India's realization of the deficiencies of having legislation by sectors (Khan, 1994). At the Bhopal disaster in December 1984, a highly toxic substance, methyl isocynate leaked from the Union Carbide pesticide plant, killing 2,500 and leaving more than 200,000 people maimed for life, resulting in many to believe that this was one of the world's worst industrial disasters (Abraham & Abraham, 1991). This disaster prompted India to promulgate in May 1986 the Environment (Protection) Act (hereafter the Environment Act), the most comprehensive environmental law in India.

These aforementioned Acts contributed to the establishment of institutional bodies, namely, the Central Pollution Control Board and the State Pollution Control Boards, to carry out the legislative objectives. The Boards were empowered to prescribe conditions and standards to prevent, control and abate environmental deterioration and promote environmental conservation. Prior to the Bhopal disaster, the Central Pollution Control Board was assigned an advisory role to the Central Government and provided technical assistance, guidance, training and relevant information to State

Pollution Control Boards. The State Pollution Control Boards in turn implemented the main regulatory tasks, as well as, advisory functions, information collection and dissemination, and planning and executing comprehensive programmes pertaining to the prevention and control of water and air pollution (Khan, 1994; Vibhute, 1995).

With the new legislations, the State Pollution Control Boards were given important additional functions including: to lay down, modify or annul standards of water and air; to inspect industrial and treatment plants; and to punish accordingly, the polluters of the streams and the atmosphere. To enable them to carry out these functions, the State Pollution Control Boards were given the authority to: enter and inspect any factory; obtain information; take and analyze samples of effluents; prosecute polluters; order the closure of a defaulting industrial unit; and withdraw the supply of power, water or other services (Vibhute, 1995). By virtue of the Environment Act, the Central Pollution Control Board was given authority almost identical to that exercised by the State Pollution Control Boards, under the Water and Air Acts. The Central Pollution Control Board was vested the authority to plan and execute nationwide programmes for the prevention, control and abatement of environmental pollution and to enforce air, water and soil quality standards and standards for the discharge of pollutants. The Environment Act also empowered the Central Pollution Control Board to enter and inspect premises, take samples of emissions and effluents and have them analysed in established or designated environmental laboratories. This strengthened the Boards' and the government's capacity to penalize polluters (Khan, 1994; Vibhute, 1995).

Another important development that has taken place since the 1980s with regard to the Indian legal system relates to citizens' power to prosecute under Indian environmental laws. Prior to the enactment of the Environment Act, the right to prosecute belonged exclusively to the government. Citizens had no direct statutory support to file a petition against polluters. However, under Section 19 of the Environment Act, a citizen can prosecute an offender by filing a complaint with a magistrate. Following this provision, the Water and Air Acts were amended in 1988 and 1987, respectively, allowing citizens' participation in the enforcement of pollution laws. Both amended sections require the Pollution Control Boards to make available relevant internal reports to citizens seeking to prosecute a polluter (Greer & Singh, undated). However, one limitation involves the need to provide a 60-day advance notice to the appropriate authority of the industry prior to the filing of an official complaint. This not only causes delay in prosecuting an industry that has been polluting the environment and allows it to continue harming the environment during this period, but it also provides the industry the opportunity to destroy any evidence of the alleged violation. Moreover, with regard to information accessibility, an individual may have the right to request information from the Pollution Control Boards but not the right to demand it from the polluter to sustain the claim in a court of law (Abraham & Abraham, 1991).

Despite the enactment of the Environment Act, the law continues to experience operational difficulties arising from the lack of skilled personnel, scientific expertise and general environmental awareness (Cheyne & Purdue, 1995). To assess the extent to which the Environment Act is being implemented, the pollution of the Ganges River by India's factories will be examined. The Ganges River, long celebrated in Hindu mythology for its purifying powers, has furnished the cultures on its banks and beyond, with water, crops, fish and a means for conducting trade. The Ganges River passes through eight states and brings sustenance to the Indo-Gangetic plain, one of the world's most fertile area. Although Hindus still pay homage to this holy river believed to have some magical self-cleansing properties that can absorb any amount of contamination, its perceived powers are increasingly burdened by the staggering volume of untreated wastes from the half-billion people living along it.

The Ganges River case study

A quarter of India's 900 million people live along the banks of the Ganges. Hundreds of thousands of factories are situated along its 2,500-kilometre stretch and its waters irrigate nearly half of India's 600,000 villages (Chakravarty, 1994). One hundred and fourteen cities, each with 50,000 or more inhabitants, dump untreated waste into the Ganges River every day. Pesticide factories, tanneries, paper and pulp mills, petrochemical and fertilizer complexes, rubber factories and many others pour their waste directly into the Ganges River. In the late 1980s, in Kanpur, Uttar Pradesh state, only three of the city's 647 factories had wastewater treatment plants. The rest disposed their industrial effluents, about 200 million liters a day, directly into the Ganges River (Centre for Science and Environment, 1989).

To combat the pollution of the river, former Prime Minister Rajiv Gandhi started the US$270 million Ganga Action Plan (GAP) almost 15 years ago. Rajiv Gandhi in 1985 vowed that the first phase of the plan would treat 873 million liters of the 1.34 billion liters of waste

poured daily into the Ganges by 25 cities. The GAP was also to detoxify 260 million litres of effluents dumped into the Ganges by 264 highly polluting factories in the states of Uttar Pradesh, Bihar and West Bengal (D'Monte, 1996). However, it has become apparent in recent years that GAP has not achieved the targets that had been set. The leather tanneries in Kanpur, one of the major polluting industries on the Ganges, discharge chromium that turns drinking water green. It is estimated that 40 million work-days a year are lost to water borne diseases from the Ganges River (Sampat, 1996). Of the 150 tanneries along the River Ganges that discharge toxic chromium into the river, only about 25 have installed pollution control facilities (D'Monte, 1996).

The lack of compliance to environmental laws may be political. The Pollution Control Boards have sometimes been accused of being "very soft" to those industries which assist political parties in power. Moreover, since the central government (or its delegated authority) formulates plans and programmes and makes decisions often in favor of rapid economic development, it tends to overlook vital environmental considerations proposed by the Pollution Control Boards (Vibhute, 1995).

In 1988, M.C. Mehta, a well-known lawyer, filed a petition requesting that appropriate actions be taken against some 75 tanneries located on the banks of the Ganges River at Jajmau near Kanpur. The case was filed based on the evidence that the tanneries had discharged effluents causing damage to aquatic life and to the life of the people who used the water of the Ganges River. Based on the testimony of environmental experts from the Department of Environment and other non-governmental bodies, there was no dispute about the volume or the toxicity of the tanneries' effluents causing pollution of the Ganges (Khan, 1994). The scope of this legal case broadened to such an extent that all the industries and all the municipal towns in the river basin came under scrutiny. As a result, the Supreme Court instructed more than 5,000 factories to install air and water pollution control devices. And during the last few years, the Supreme Court ordered a few hundred factories that did not comply with the Court's order to close until they install pollution control devices and meet the legally prescribed standards (Multinational Monitor, 1995).

The counterarguments given by the owners of the tanneries stated that the inevitable consequence of the tanneries' closure would be large-scale unemployment that might contribute to social unrest. Despite the Supreme Court's threat to close down the factories, the deadline for closure was extended to allow the industries time to install the needed facilities. The Supreme Court settled on designing a time frame within which pollution control measures had to be carried out to achieve the objectives set by the petitioners. The Supreme Court claimed that if the factories were ordered to adopt these measures immediately, the cost would be prohibitive and the factories would not be able to produce goods or offer services that were competitive (Sunday Observer, 13/07/97).

But in fact the industries are not the main culprit for the pollution of the Ganges since only thirty percent of the pollution load comes from industry. The remaining 70 percent comes from domestic wastes. And since courts cannot close down cities, people clearly must be involved to resolve the problem. For example, along the banks of the Ganges there are burning ghats or funeral pyres where the last rites of thousands of people are performed. Owing to the steep rise in the prices of firewood in recent years, bodies are often only half-burnt and then dumped into the river, adding significantly to its contamination. Under GAP, electric crematoria are supposed to substitute for burning ghats. However, these electric crematoria are located in places where there are no electricity. Thus only one in four crematoria erected in Uttar Pradesh is functioning. Clearly, the participation of the local people in this particular case may have helped avoid such error (D'Monte, 1996).

The institutional and legal concerns highlighted by the Ganges River case may be summarized as follows:

- The environmental sanctions set by the government are considered by some to be too lenient for fear that strict control would lead to massive unemployment and social unrest. This case shows that environmental concerns cannot be considered in isolation from people's livelihood. Only when there is political will and social development programmes are in place that environmental protection can be effectively implemented.
- The case shows the inadequacy of people's participation in the legal process despite the fact that they are given the right to prosecute under the law. To remedy this, environmental law should encourage the design of realistic standards by setting up a time frame for industries within which pollution control measures have to be carried out. Failure to meet the objectives within the prescribed period should result in strict sanctions in terms of fines and imprisonment.

The human resources and technical concerns include the following:

- The members of the Pollution Control Boards do not necessarily possess the needed theoretical and practical knowledge of matters relating to environmental protection. This has critical implications on the implementation of environmental legislations. Thus it is important that officials are kept up to date about environmental management methodologies. Capacity building for environmental management needs to be emphasized to improve government officials' understanding of and competence in dealing with environmental issues.
- The lack of skilled personnel, scientific expertise and general environmental awareness may be a key weakness in the implementation of environmental law and policy. It is important to nurture the growth, both qualitatively and quantitatively, of environmental experts, to increase the quality of proof of environmental damage. This could be achieved by establishing a forum that fosters environmental interests and environmental information exchange. Legislations and policies that promote the importance of environmental management in research,educational curriculum and development planning by, for example, allocating resources to these initiatives may be a key to the effective implementation of environmental law. The development of public awareness campaigns on environmental issues is essential since environmental awareness needs to be assured before people can advocate for and participate in environmental management.

The case study shows that a major informational concern is the limited access to relevant information despite the fact that citizens have the right to obtain information from the Pollution Control Boards. This should be remedied by new legislations that would ensure the citizens' right to have access to relevant information from both the authorities and the project proponents.

2.4.4 *Papua New Guinea*

At independence in 1975, the Independent State of Papua New Guinea (PNG) adopted a Constitution which declared as a Fourth National Goal the duty to conserve and use the nation's resources and environment for the collective benefit of the nation and to replenish those resources for the benefit of future generations. In 1977 this goal was adopted as a government policy when Parliament adopted it in the form of the "Environment and Conservation Policy: A Statement of Principle". The document stated in part that: "Pollution of the land, air, water and seas in quantities which are likely to be dangerous to human health, to plants and to animals, and cause damage to the environment must be prevented" (Office of Environment and Conservation, 1976, cited in Kula-Kalinoe, 1994: 24). These policy statements, however, could not be enforced in a Court of Law and could be used only as "guides" to arrive at a decision. Nonetheless, shortly afterwards, in 1978, three environmental laws were passed by Parliament, namely, the Environment Planning Act, the Environment Contaminants Act and the Dumping of Wastes at Sea Act. A fourth statute, the Water Resources Act, was enacted in January 1981. The Department of Environment and Conservation (DEC) was established and made responsible for monitoring environmental damage and enforcing environmental law.

Many people agree that the PNG government has adopted an ecologically and environmentally sound environment policy in its attempt to manage its natural resources. However, some hold reservations as to the extent to which the government's environmental policies can be implemented because of the state's lack of capability and adequate resources to manage and protect the environment. By the end of 1988, DEC had only 14 staff members and a budget of only 30,000 Kina (US$21,430). This was increased to 70,000 Kina (US$50,000) in 1989. With a limited budget, its duties included the issuance of detailed guidelines for the preparation of environmental plans, the monitoring of environmental impacts, and the enforcement of regulations (Ongwamuhana, 1991).

PNG's ability to implement its environmental legislation will be examined with reference to its mining sector, particularly at the Ok Tedi mine. While PNG has adopted a commendable environmental policy, it has also committed to an economic policy of growth, particularly in the agricultural, forestry and mining sectors. The mining sector, in particular, plays a very significant role in the economy of PNG, accounting for 15 percent of the GDP and 65 percent of the total export earnings in 1988 (Ongwamuhana, 1991).

The Ok Tedi Mine case

The Ok Tedi mine is a gold and copper project located on Mount Fubilan in the Western Province near the border with Indonesia. The mine is located on the banks of the 200-kilometre long Ok Tedi River. The

Ok Tedi River flows into the Fly River, which empties into the Gulf of Papua. The mine started production in June 1984 with a projected lifespan of 30 years. It is operated by Ok Tedi Mines Ltd. (OTML) and is 52 percent owned by Australia's Broken Hill Pty. Co. Ltd. (BHP), 18 percent by Canada's Inmet Mining Corporation, and 30 percent by the PNG government (Sydney Newsroom, 1996). Ok Tedi produces 200,000 tonnes of contained copper and 350,000 ounces of gold annually comprising all of PNG's copper and about 18 percent of its total gold output (Melbourne Reuters, 1994).

With all the revenue it generates for PNG, the activity also generates huge amounts of waste, about 100,000 tonnes per day. The Fubilan mountain is believed to hold 30 million tonnes of gold ore and 150 million tonnes of copper ore. At the end of the mine's lifespan, it is expected that Mount Fubilan will have disappeared, discharged in the form of tailings down Ok Tedi River and Fly River (Ongwamuhana, 1991). The mine tailings not only fill up the river banks, forcing changes on the river's course and its ecosystem, but the cyanide and residual copper in the tailings also cause severe contamination of the river. Consequently, the lives of the Ok Tedi and Fly River communities have been severely affected (ABC, 1995b). Some scientists believe that the contamination may extend into the Torres Strait, which separates New Guinea and Australia, and as far south as the Great Barrier Reef, although evidence remains contradictory (Anderson, 1994). The damage resulting from the mining wastes can be reduced to acceptable levels by the construction of costly tailings storage and treatment facilities, but this additional cost naturally reduces the financial return to the developer and the State. Unfortunately, in the mining sector, few are concerned about long-term consequences due to the short lifespan of the mines.

In May 1994, the law firm, Slater & Gordon, on behalf of 73 land owners who claimed to represent 30,000 local residents affected by the pollution of the Ok Tedi and Fly Rivers, launched a Australian $4 billion (US$2.84 billion) legal claim against BHP. The claim included the damage done to the communities over alleged river pollution during the past 11 years, the construction of a tailings dam, and a court order to stop further mining until a dam was built. The legal action was taken only against BHP because it was the operator and decisions regarding the mine were taken at the BHP's head office in the Victorian state capital of Melbourne (Melbourne Reuters, 1994). Under clause 29 of the 1976 Agreement, OTML was prevented from disposing tailings by means other than that approved under the project proposal, which required the containment of tailings in a dam. OTML was also required to install equipment for analyzing waste discharges and provide the State with statistics on the quantity and quality of the discharges. If the company was unable to prevent pollution, the State was mandated to clear or contain the contamination but the company would have to compensate the State.

According to OTML's original tailings disposal plan, the tailings from the Ok Tedi mine were to be contained in a tailings dam at Ok Ma. But the planned dam collapsed during construction in January 1984, as a result of a massive landslide, resulting in a loss of US$64 million to the company. Since the State partially owned OTML, it also incurred a considerable loss as a result of this incident (Ongwamuhana, 1991). After the collapse of the tailings dam and five months before production was due to start, OTML negotiated a Supplemental Agreement with the State allowing it to discharge tailings into the Ok Tedi River as an interim measure. This Supplemental Agreement was further extended in March 1986, allowing OTML to continue discharging its waste into the river and postponing to January 1990 the construction of a permanent tailings dam (Ongwamuhana, 1991). But by 1990 the dam was still not built. Still the mine developer argued that the mine complied fully with PNG law and had the full support of the PNG government.

The PNG government feared that if the case was tried in court, it would cause political unrest in PNG. Thus, in May 1995, the Restated Eighth Supplementary Agreement was passed by Parliament providing a compensation package of A$110 million but only to landowners not involved in any future legal action to pursue the construction of the tailings dam. The agreement stated that the compensation would be paid into the communities' trust account, bypassing the provincial government account, but only when the communities withdraw their court order for a tailings dam (ABC, 1995a). This legal issue was settled in June 1996. The negotiated solution involved the payment of compensation to the river and other communities affected; studies on ways to reduce the environmental impacts from the mine operations; and a commitment to implementing any technically and economically feasible solutions. OTML paid 14 million Kina (US$1 million) into a trust for distribution to Ok Tedi and Fly River communities and would pay an additional 4 million Kina annually as long as the mine continued in operation. A PNG company, Heduru Pty Ltd, as trustee of the Western Province General Compensation Trust, has been handling the distribution of compensation payments to the river communities. Heduru's Board of Directors is comprised of 3 village

representatives, 2 government representatives and 2 OTML representatives (BHP, 1996).

Questions remain as to OTML's and the government's commitment to environmental protection. The compensation to the villages provides only partial short-term solution since compensation does not mean that the environmental damage will be reduced. Furthermore, the villagers still have little say in the decision-making process regarding development in their region. They also have little access to or control over the trust account, how it is to be distributed and what the money is to be used for.

Prior to production, OTML was not required to undertake an environmental impact assessment even though this was mandatory under the Environment Planning Act. During the Ok Tedi negotiations following the collapse of the tailings dam, the State was concerned that OTML might cease operations resulting in the loss of its equity financed from overseas loans and the loss of substantial tax revenues. The State was worried also that stringent environmental protection requirements would require expensive capital injection into the project forcing the State to bear some of the additional costs as shareholder (Ongwamuhana, 1991).

Another important point is the overlapping responsibility between the DEC and the Department of Minerals and Energy (DME) in granting a mining lease, reducing the DEC's authority to enforce environmental law (Ongwamuhana, 1991). The DEC and DME also share the responsibility of monitoring pollution from mining activities. However, because of resource constraints, the monitoring process is often left entirely to the mining companies who are expected to be self-regulating. Unfortunately, experience at Ok Tedi demonstrates that the self-regulation arrangement has not been successful in protecting the environment. It has been suggested that the State agencies should have an effective presence at mining sites (Ongwamuhana, 1991). But to be able to do this, they must be adequately funded and provided with skilled personnel. The present level of funding for this purpose does not indicative serious commitment of the State to environmental protection.

According to the initial agreement, there was a set of maximum allowable levels of cadmium, copper and cyanide concentrations in the river. But the monitoring points for compliance with these standards were about a hundred kilometres downstream of the mine. This meant that a hundred kilometres of the river were sacrificed to the mine. In fact this area was literally acknowledged as a "sacrifice zone" and was not monitored because there was virtually nothing living in it (ABC, 1995b).

The Ok Tedi case emphasizes the need to address adequately a number of institutional and legal concerns:

- The environmental sanctions are considered to be too lenient for fear that strict controls would steer away investment gains and lead to social unrest. The State's decision to buy shares in mining companies operating in the country and its dependence on mining revenues for economic development have resulted in a conflict of interest, which compromises its ability to enforce controls. At the same time, the difficulty of convincing the private companies to construct costly storage and treatment facilities due to the short life span of the mines means that there is little incentive for private organizations to comply with the law. Thus the introduction of criminal sanctions in terms of fines and imprisonment should be considered. And the command and control approach should be combined with innovative economic instruments.
- The problem of complying with the initial agreement is believed to be the result of unrealistic standards being set and a lack of political will to commit to environmental protection. Therefore, environmental standards should be set realistically by, among others, creating a forum whereby key stakeholders can participate in the discussions to reach an agreement on environmental standards.
- The monitoring function is left entirely to the mining companies who are expected to be self-regulating. It should be mandated by law that government agencies, non-governmental organizations and local communities are able to take part in environmental monitoring.
- The development of the communities' trust account by-passing the provincial account may be a good step forward towards improving the environment and people's livelihood, but questions remain with respect to the extent to which the local community has access to and control over the trust account. Environmental law should be designed to encourage the strengthening of civic groups and communities in order for them to participate effectively in managing such trust accounts.

The case study indicates that the provision of a compensation package alone will not solve environmental problems. In addition to financial resources, it is also important to provide the following:

an institutional framework in which environmental concerns can be voiced and resolved; trained and capable human resources committed to environmental protection; and ready access to environmental information.

The Ok Tedi case study also shows that one of the critical problems in formulating and implementing environmental laws is the lack of expertise about PNG's environmental, social, economic and political issues. The development therefore of skilled personnel in the field of environmental management should be given highest priority. These skilled personnel, together with the policymakers and the legal practitioners, should be encouraged by law to share information and experiences, as well as work together, particularly in legal cases relating to potential environmental damage.

2.4.5 Limitations of the command and control approach

Based on the case studies, some common problems with the so-called command and control approach can be identified. They are categorized into institutional and legal constraints, financial constraints, human resources and technical constraints, and informational constraints.

Institutional and legal constraints

- The marginalization and lack of power of environmental agencies thereby reducing their ability to enforce regulations.
- The existence of broad policy statements that lack specific goals and priorities and not supported by relevant planning procedures and management.
- The problem of unclear demarcation of responsibilities.
- The problem of overlapping state's departmental responsibilities and control.
- The problem of unclear formulation of environmental standards.
- The problem of the standards not being complied with.
- The problem of inadequate monitoring systems to regulate the discharge of undesirable substances.
- The lack of public participation prior to, during and after the implementation of the project

Financial constraints

- The insufficient financial resources allocated to or generated by the environment sector for environmental protection.
- The general lack of incentives for companies to comply with environmental laws due to their concern about the short-term profit gain.
- The lack of funds for the maintenance and operation of existing environment projects.
- The lack of investments on activities focusing on capacity building

Human resources and technical constraints

- The lack of skilled personnel, experience and know-how in most sectors and levels to implement environmental laws. More significantly, it is not required, in the case of China and India, for personnel in environmental agencies to have professional knowledge on environmental issues.
- The government suffers from a lack of political will to implement environmental laws especially since economic development is considered to be the priority and is vigorously pursued without regard for its long-term negative effects on the environment, resulting in environmental sanctions and penalties being too lenient particularly on investors and industries that assist the political party in power and for fear that strict controls would steer away investment gains and lead to social unrest.
- Environmental impact assessments for governmental and private sector projects and activities become merely a pro-forma procedure. The carrying out of an EIA is regarded as an additional cost rather than as a means for protecting the environment.

Informational constraints

- The difficulty of proving the sources and causes of environmental damages.
- The difficulty of forecasting the environmental implications of a project that has yet to be implemented.
- The inaccessibility to information that are important as evidence when filing lawsuits against polluters.

Conclusions

As all the cases have shown, environmental protection cannot and should not be the sole responsibility of the public sector. The involvement of other stakeholders is crucial because the state of the environment affects people's health and standard of living. All cases show the importance of greater environmental awareness,

pressure from political constituencies, and public participation in the decision-making process.

Although most legislations recognize the right of individuals to prosecute polluters, in practice, this is not that easy to do. There is the problem of burden of proof, especially when the plaintiff do not have the legal rights to obtain relevant information from the polluters and from the government to support his or her claim in a court of law. There is also the issue of the payment of fees when filing lawsuits or seeking compensation, of which the majority of the population may not be able to afford. Finally, there is the problem of the lack of qualified legal advisory centers and government support to those citizens who wish to file complaints.

Despite the fact that many countries in the Asia-Pacific region have begun to explore the possibility of incorporating economic instruments, public participation, decentralization and regional cooperation in their environmental legislations, the procedures for carrying out these ideas and concepts remain vague and ineffective. Finally, although common problems can be identified in the region, each individual country has specific conditions that are culturally determined. The cultural aspect of the individual country and the region as a whole also needs to be considered when formulating and implementing environmental legislations.

REFERENCES

Abraham, C.M. & Abraham, S. (1991). "The Bhopal Case and the Development of Environmental Law in India," International Comparative Law Quarterly, Vol. 40: 334-365

ASEAN (1997). First ASEAN State of the Environment Report, Association of South East Asian Nations (ASEAN).

Atkinson, A. (1991). "Environment and development: concepts and practices in transition," Public Administration and Development, Vol. 11: 401-413

Bachner, B. (1993). "Coming Home To Roost: Pollution, Law and Economics in the People's Republic of China," Georgetown International Environmental Law Review, Vol. 5:635: 636-650

Baker & McKenzie (1993). Thailand: An Environmental Law Brief 2nd edition, Baker & McKenzie, Bangkok.

Centre for Science and Environment (1989). "The environmental problems associated with India's major cities," Environment and Urbanization, Vol. 1(1): 7-15.

CER (1997). "The environment: gradually becoming a mainstream issue," China Economic Review, Vol. 1(1): 2-4.

Cheyne, I. & Purdue, M. (1995). "Fitting definition to purpose: the search for a satisfactory definition of waste," Journal of Environmental Law, Vol. 7(2): 149-

Kaosa-ard, M. (1998). "Economic Development and Institutional Failures in Thailand," Thailand Development Research Institute Quarterly Review, Vol. 13(1): 3-11

Khan, R. (1994). "Environment v. Development Revisited: Contributions of India's Judiciary to the Conflict Resolution," Asian Yearbook of International Law, Vol. 2: 11-48

Kojima, R. (1997). "State of the environment in China," in S. Nisihira, R. Kojima, H. Okamoto & S. Fujisaki's, Environmental Awareness in Developing Countries: The Cases of China and Thailand, Institute of Developing Economies, Japan, pp. 46-73.

Kuna-Kalinoe, L. (1994). "Water Resource Management in Papua New Guinea law, Policy and Practice," Melanese Law Journal, Vol. 22: 23-40

Levy, C. (1992). "Gender and the environment: the challenge of cross-cutting issues in development policy and planning," Environment and Urbanization, Vol. 4(1): 134-149

MOSTE (1997). Thailand's Action for Sustainable Development, Ministry of Science, Technology and Environment, Bangkok.

Munro, G.R. (1993). "Environmental Cooperation among Pacific Developing Coastal States: A Fisheries Case Study," U.B.C. Law Review, Vol. 27: 201-212

Nicro, S. (1997). Public Participation in Environmental Impact Assessment (EIA) in Thailand: Case Studies: Thailand, Indonesia, Malaysia, The Philippines and Canada, Thailand Environment Institute, Bangkok.

Ongwamuhana, K. (1991). "Mining and Environmental Protection in Papua New Guinea," Environmental Planning Law Journal, 133-144

Paisley, R.K. (1993). "Sustainable Development, The Environment and The Pacific Rim: Looking Ahead to the 21st Century," U.B.C. Law Review, Vol. 27: 107-111.

Prapertchob, P. (1997). "Industrialization and environmental disputes: a case study of the Nampong River," in S. Nisihira, R. Kojima, H. Okamoto & S. Fujisaki's, Environmental Awareness in Developing Countries: The Cases of China and Thailand, Institute of Developing Economies, Japan, pp. 257-267.

Profaizer, J.R. (1993). Economic Development and Environmental Law in China's Special Economic Zones, Texas International Law Journal Vol. 28: 319-355.

Richardson, B. (1990). "A Study of the Response of Transnational Environmental Law and Policy to the Environmental Problems of East Asia and the South Pacific," Environment and Planning Law Journal, 209-228.

TEI (1995). Executive Summary: Decentralizing Environmental Management - Participatory Approach, Thailand Environment Institute (TEI) 1995 Annual Conference, Bangkok.

UNEP (1998). State of the Environment in Asia and the Pacific (GEO-2 Input), United Nations Environment Programme, Bangkok.

Vibhute, K.I. (1995). "Environment, Development and the Law: The Indian Perspective," Journal of Environmental Law, Vol 7(2): 137-148.

Zhou, D. (1992). "Environmental Considerations in the Economic Development of China," Arizona Journal of International and Comparative Law, Vol. 9(1): 221-230.

Newspaper Articles

Bangkok Post 30/06/96

Bangkok Post 16/09/96

Bangkok Post 20/09/96

Bangkok Post 29/09/96

Bangkok Post 17/06/97

Bangkok Post 07/08/97

Bangkok Post 17/08/97

Bangkok Post 11/11/97

Bangkok Post 16/11/97

Internet sources

ABC (1995a). "Radio National Transcripts: BHP accused of supporting undemocratic legislation in Papua New Guinea."
[http://www.green.net.au/boganv/okinf25]

ABC (1995b). "Radio National Transcripts: The Money or the Dam?"
[http://www.abc.net.au/rn/talks/bbing/bb950528.htm]

Anderson, I. (1994). "Villagers sue mine over ruined river" in New Scientist.
[http://www.green.net.au/boganv/okinf19]

BHP (1996). "First Step to Distribution of Ok Tedi Compensation."
[http://www.green.net.au/boganv/okinf01.htm]

Chakravarty, P. (1994). "India's Holiest River Becoming A Toxic Nightmare" in "Agence-France Presses."
[http://www.prakash.org/issues/environment/pollution/envafp19941108_00.html]

China Embassy (undated). "Three Gorges Environmental Protection Program Launched."
[http://www.china_embassy.org/Cgi-Bin/press.pl?110]

China Report (undated). "Three Gorges Dam Project: The Biggest Dam in the World Will Tame the Yangtze."
[http://www.chinareport.com/3grg.htm]

Daiwo (undated). [daiwo@pop.hkstar.com] "Planet 1: Three Gorges Project"
[http://home.hkstar.com/ ~daiwo]

D'Monte, D. (1996). "Filthy flows the Ganga."
[http://www.oneworld.org/textver/patp/vol5_3/ganga.html]

Ex-Im Bank (undated). "Frequently Asked Questions About the Three Gorges Dam Project."
[http://www.exim.gov/3gorges.html]

Greer, J. & Singh, K. (undated). "Legal Actions of TNCs."
[http://www/corpwatch.org/trac/resrch/legal.html]

IRN (International Rivers Network) (1997). [irnweb@irn.org] "Three Gorges Dam Update: Stopping the flow of foreign support will help stop the project."
[http://www.irn.org/programs/theeg/update971101.html]

Reuters, Melbourne (1994). "PNG villagers sue BHP for $2.8 billion over pollution."
[http://www.green.net.au/boganv/okinf22]

MPI (undated). "Social Impact."
[http://parallel.acsu.unsw.edu.au/mpi/issues/social.html]

Multinational Monitor (1995). "Harnessing the Law to Clean up India."
[http://www.essential.org/monitor/hyper/mm0795.09.html.safety]

O'Neill, M. (1997a). "Power to the Yangtze."
[http://wwwpathfinder.com/asiaweek/98/0508/feat2.html]

O'Neill, M. (1997b). "Project symbolic for both sides of argument."
[http://www.scmp.com/news/special/ThreeGorges Dam.asp? Article_Id = 19971105191514924]

Sampat, P. (1996). "The Ganges: Myth and Reality."
[www.worldwatch.org/worldwatch/mag/1996/96-4.html]

Saran, M. (1998). "The Three Gorges - Dam Ambition: Critics from China on communities in deep water."
[http://www.scmp.com/news/special/ThreeGorges/Dam.asp?Folio=proscons]

Soundnet (1997). "Environment-China: Banned voices speak on Three Gorges Dam."
[http://www.nor.com.au/community/oceania/soundnet/dec97/damba]

Sunday Observer (1997). "Role of the judiciary vis-a-vis the Rule of Law."
[http://www.lanka.net/lakehouse/1997/07/13/intropol.html]

Sydney Newsroom (1995). "Australia: PNG Mining Body Says Ok Tedi Landowners Misled."
[http://www.green.net.au/boganv/okinf08]

The Times of PNG (1994). "Compo Claim for Ok Tedi Could Cost K6 Billion."
[http://www.green.net.au/boganv/okinf20]

Tiyaamornwong, K. (1997). "The Damming of the Yangtze River.
[http://mamba.bio.uci.edu/~pjbryant/global/sen_sem/tyaa97.htm}

UNEP (1997). [eluinfo@unep.org] "About the UNEP Environmental Law Programme."
[http://www.unep.org/unep/program/global/elu/internet.htm}

U.S. Embassy Beijing (1996). "Rapid Progress in the Three Gorges Dam."
[http://www.Redfish.com/USEmbassy-China/sandt/3gorcap.htm]

CHAPTER 3

Current Policy Initiatives

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Current Policy Initiatives

3.1 INTRODUCTION

Many countries in the Asia and Pacific region have adopted various policy initiatives to make environmental conservation an integral feature of their development plans. The initiatives included: laws and institutions; regional cooperation; economic instruments; cleaner production; national and international finance; voluntary actions; information dissemination; social policies and international agreements. Different initiatives have varying degree of impacts on preservation of environment. Policy relies mainly on command and control instruments, such as strategic environmental planning, legislation, and regulatory standards. Economic tools have also been applied to promote cleaner production and to improve the environmental performance of private sectors. Non-Governmental Organizations (NGOs) perform key roles in protecting the environment, especially in promoting environmental awareness. Details of the each initiative are discussed in the following sections.

3.2 LAWS AND INSTITUTIONS

The decades following the 1972 Stockholm Conference on the Human Environment witnessed the development of many environmental laws and regulations dealing with the protection of the environment and the management of natural resources. Throughout the region, widespread public concern over pollution led to the enactment of legislation to curb the emissions of effluents and airborne pollutants, while concerns over the depletion of natural resources led to legislation for resource conservation and for the preservation of areas of special biological value. There were many challenges associated with this new legislation, particularly in the developing countries of the region, arising from the conflicts between environmental and resource conservation and the genuine needs for rapid economic growth and development. The enforcement of environmental legislation therefore remains an elusive goal despite the strengthening of legislation in recent years. Table 3.1 presents a summary of the environmental legislations and institutions in the region.

South Asia

Contemporary trends in South Asia indicate that institutions involved with environmental governance and protection are being strengthened. Many new public sector institutions have been established, including environmental ministries, while independent environment agencies and departments have been created to assist them. Environmental impact assessments (EIAs) are becoming widely institutionalized while several countries are evolving National Environmental Action Plans (NEAPs), often implemented with the close involvement and participation of local people and NGOs. For instance, among the initiatives taken since GEO-1 have been the following: Bangladesh - introduction of mobile courts for vehicular air pollution control; India - formulation of draft legislation on biodiversity and treatment of hospital wastes; Pakistan - establishment of Pakistan Environmental Protection Act, Dec 6, 1997 and setting up under this act Pakistan Protection Agency at Federal level, Provincial Protection Agencies, Provincial Sustainable Development Fund and Provincial Environmental Tribunals; Nepal - establishment of Environmental Protection Act and Rules 1997 for internalizing EIA, pollution control, establishing environment fund, community forest policy for handing forest land to local people; Bhutan - environmental legislation being drafted and NEPA to be set up; Maldives - formulation of draft Second National Environmental Action Plan (NEAP); Iran - recent regulatory set up for environmental impact assessment and environmental monitoring.

Southeast Asia

Since the late 1970s and 1980s, most ASEAN countries have developed comprehensive environmental legislations in contrast to the earlier somewhat piecemeal approach when rules and regulations to protect the environment and control the utilization of natural resources were on a more sectoral basis (fisheries, forest, mining, emissions, etc). All such laws and regulations have been substantially revised, updated and expanded to cover contemporary areas of concerns such as pollution control, nature conservation, protection of public health and the control of toxic substances and

Table 3.1: A summary of the environmental legislations and institutions in the Asia-Pacific region.

Country	Selected environmental laws	Institution
Brunei Darussalam		National Committee on Environment (NCE) [Chaired by Minister for Development with Permanent Secretaries of other Ministries as members]
Indonesia	1982 Environmental Management Act (EMA) No. 4	State Ministry of Environment
Malaysia	Environment Quality Act 1974 (Amendment, 1985)	Department of Environment at the ministerial level; and the Environmental Quality Council (EQC) [a multi-sectoral advisory body]
Philippines	The Pollution Control Law 1976; Philippine Environmental Policy 1977 (Presidential Decree No. 1151); Philippine Environment Code 1977 (Presidential Decree No. 1152)	Department of Environment and Natural Resources (DENR)
Singapore	Environment Public Health Act (Cap 95); Clean Air Act (Cap 45)	Ministry of the Environment (ENV)
Thailand	1975, 1978, 1979, 1992 Enhancement and Conservation of National Environment Quality Act	National Environment Board [chaired by the Prime Minister with the Permanent Secretary of MOSTE as secretary] and the Ministry of Science, Technology and Environment (MOSTE)
India	Water (Prevention and Control of Pollution) Act 1974; the Air (Prevention and Control of Pollution) Act 1981; the Environmental (Protection) Act 1986	Central Pollution Control Board State Pollution Control Boards
China	1979, 1989 Environmental Protection Law of the People's Republic of China	State Commission on Environmental Protection National Environmental Protection Agency
Papua New Guinea	1978 Environment Planning Act; 1978 Environmental Contaminants Act; 1978 Dumping Wastes at Sea Act; 1981 Water Resources Act	Department of Environment and Conservation (DEC) at the ministerial level

Sources: ASEAN, 1997; Bachner, 1993; Ongwamuhana, 1991; Oposa, 1996; Nicro, 1997; Thailand Environment Institute, 1997; Vibhute, 1995.

hazardous wastes. Comprehensive water protection measures are now in place, along with water quality standards, effluent standards, sanctions for violation, and strengthening of responsible bodies (ASEAN, 1997). Similarly, air pollution from increasing urbanization and industrialization has prompted the ASEAN countries to define ambient and emission standards, especially in urban and industrialized areas.

Many environmental regulations have been embodied into Thailand's Constitution to make them more binding and easier to implement (Government of Thailand, 1997). Thailand's Constitution of 1997 recognizes: the community's right to manage and utilize the natural resources and environment on a sustainable basis; the individual's right to collaborate with state and community to preserve, protect and enhance the environmental quality; the need for EIA study before implementation of any project or activity that may cause severe adverse effects on the environment; the public's right to know the information prior to permitting and implementing such projects; the citizen's duty to protect and conserve the natural resources and environment; the state's obligation to encourage and

promote public participation in the preservation, enhancement and balanced use of natural resources; and the state's duty to protect the environment based on the principle of sustainable development by controlling and eliminating pollution (MoSTE, Thailand, 1998). In the Philippines, government agencies and government corporations involved in the implementation of environmentally critical projects have been required to put up in-house environmental units as part of the effort to strengthen implementation of the environmental impact statement system. At the same time, the administration of water supply and sewerage system has been privatized, giving the private sector a central role in water resources management (Umali, NEDA, Philippines).

Environmental management in the ASEAN has also been expanded at the regional level. This has arisen from the realization that complex environmental problems are better addressed by cooperative efforts and sharing of knowledge and experiences, and that unified positions on the environment enhance the standing of the region at international forums. In 1989, the ASEAN Experts Group on the Environment was upgraded into what is now the ASEAN Senior Officials on the Environment, with membership at the level of Permanent Secretaries. The ASEAN Ministers for the Environment have also met regularly and issued a number of Joint Declarations on environmental issues of regional importance.

The six countries of the GMS sub-region are at different stages in developing their policies, laws, regulations and institutions for environmental protection and management. For example, Thailand has enacted the Enhancement and Conservation of National Environmental Quality Act of 1992 thus providing a legal framework for addressing environmental planning, regulation of pollution, funding of remedial actions, and the roles of NGOs and the public. Vietnam has created the comprehensive Law of Environmental Protection of 1994 while Myanmar has updated its legislations covering forests (1992), freshwater fisheries (1991) and wildlife protection and conservation (1994). The other countries, namely, Cambodia, Lao PDR and Myanmar, are in the process of strengthening their institutional framework for environmental protection and management.

Northeast Asia

In the East Asian region, the governments have enacted numerous environmental legislations. In Japan, legislative initiatives in the late 1960s, including the establishment of an Environment Agency, were compromised by rapid industrial growth and economic development. However, by the end of the 1980s, Japan's growing international role and the generally poor state of the national environment forced a reevaluation of environmental and development goals. New laws were enacted, for example, to reduce emissions from motor vehicles, and by 1993 the government had established a Basic Environment Plan (EA, 1994), which outlined policies and policy instruments and defined the roles of each sector of society (see Box 3.1). Similarly, after

Box 3.1: Approaches to Pollution

Japan

- Change in emphasis from crisis management to ordered control, regulation and management
- Central air and water monitoring network, operated by local government
- Self monitoring and evaluation by businesses and factories
- Strong support from the judiciary
- Strong role for local government

Republic of Korea

- Recognizing in the Constitution citizen's rights to live in a healthy and pleasant environment
- Establishing the principle of "Precautionary Prevention and the Polluter-Pays Principle"
- Restructuring the environmental law system, which consists of the Basic Environmental Policy Act (1990) as the basis for all environmental laws and twenty-four environmental laws under the jurisdiction of the Ministry of Environment
- Tightening environmental quality standards and operating the Ozone Forecast and Alert System, the Comprehensive Countermeasures for Water Management and the Volume-Based Waste Collection Fee System to create a resource recycling society
- Harmonizing regulations and economic instruments

China

- Environmental laws now cover water and air pollution, solid wastes, pollution of the Huai river, management of nature reserves, crimes for jeopardizing the environment, crimes for damaging natural resources
- Laws specifically govern the use of natural resources
- Over 30 environmental regulations and 375 environmental standards issued centrally
- Over 900 environmental regulations issued locally
- A total of 8,400 departments within the environmental protection network include 2,894 environmental protection bureaus, 2,155 environmental monitoring stations, 1,862 stations for monitoring and enforcing compliance
- Over 95,550 staff employed directly in environmental protection

Sources: Government Reports

adopting the same fast track development path as Japan, the Republic of Korea also encountered severe environmental degradation but has responded with comprehensive legislation and environment action (Government of Korea Rep., 1997).

The contemporary efforts of the Chinese government to implement environmental laws and regulations have culminated in a comprehensive Environmental Protection Law. The whole process of legislation on the environment has been stepped up and focused on implementation and enforcement, defining accountability and legal responsibility, and imposing sanctions for non-compliance. Standards constitute a major component of environmental policy and now embrace every aspect of environmental quality, pollution discharge, environmental management, and even monitoring methodology. Recent amendments to the criminal law have greatly strengthened this mandatory nature of environmental protection, and as now stipulated, any party in violation of these standards are held responsible before the law. At the institutional level, significant progress has been reported in implementing unified monitoring, inspection and management systems throughout the country, carried out by a wide range of local and central environmental organizations and responsible departments. Growing numbers of environmental professionals are now also employed in both the state and the private industrial sectors.

Australia and New Zealand

Environmental policy responses and law in Australia have attempted, particularly in recent years, to incorporate the guiding principles of Ecologically Sustainable Development (ESD). The Australian government adopted the principle of ESD as a major national strategy in 1992 (COAG, 1992) in a landmark consultative process involving the Commonwealth, State and Territory Governments and local government representatives. This defined ESD as a pattern of development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. In line with this policy, a significant new Act of Federal parliament on the environment is the Natural Heritage Trust of Australia Act 1997. The Act establishes a Natural Heritage Trust (NHT) of Australia Reserve, and allows the Trust to earn interest, and for Consolidated Revenue funds to be paid into the Trust. The NHT has targeted to spend $1.25 billion over 5 years and to keep $300 million in perpetuity as a capital base for future environmental expenditures. The Act ensures accountability through financial and annual reporting, and outlines the capital projects of the Trust which will deal directly with the preservation of Australia's natural assets, i.e., flora, fauna, soil and water resources.

Intergovernmental coordination for environmental management, including ecologically sustainable development, is principally effected through the Council of Australian Governments (COAG) and the relevant Ministerial Councils, including Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Australian and New Zealand Environment and Conservation Council (ANZECC), Murray Darling Basin Ministerial Council (MDBC), National Environment Protection Council (NEPC), and National Health & Medical Research Council (NH&MRC). COAG is composed of the heads of the Commonwealth, State and Territory governments and the President of the Australian Local Government Association (ALGA). Other significant policies and strategies in Australia include: the National Forest Policy; the National Water Quality Management Strategy (NWQMS), which focuses on integrated catchment management and addresses both diffuse and point sources of contamination; and the National Strategy for the Conservation of Biological Diversity (NSCBD). The NSCBD, through a series of clear objectives, is how the Convention on Biological Diversity will be implemented in Australia. Australia ratified the Convention on Biological Diversity in June 1993, and is a signatory to numerous multilateral and bilateral agreements on the environment (Environment Australia GEO-2 Input, 1998).

Environmental management in New Zealand was extensively reformed in the late 1980s and early 1990s. The national laws and institutions dealing with the environment were reduced in number and made more coherent. Key laws are: the Environment Act 1986, the Conservation Act 1987, the Resource Management Act 1991, the Forests Act 1949, the Fisheries Act 1996, the Hazardous Substances and New Organisms Act 1996, and the Biosecurity Act 1993. The philosophical centerpiece of New Zealand's environmental laws and institutions is the Resource Management Act 1991. The central government has the primary responsibility for environmental issues where there is a clear national interest (e.g. maintaining national parks and reserves on public lands, protecting endangered species, controlling the introduction of hazardous substances and new organisms, sustaining fisheries, and dealing with global issues such as ozone depletion, climate change, trade in endangered species, protection of whales and conservation of straddling fish stocks). The central government can also set national policies, standards or guidelines to ensure that local authorities

manage environmental issues in ways that are nationally consistent. However, most environmental decision-making is in the hands of locally elected authorities in 16 catchment-based regional councils and nearly 80 territorial authorities (New Zealand GEO-2 Input, 1998).

3.3 REGIONAL COOPERATION

At the regional level, some examples of environmental cooperation include such intergovernmental bodies as ASEAN, the International Centre for Integrated Mountain Development (ICIMOD), the Mekong River Commission, the Mekong Region Law Centre (MRLC), the South Asia Cooperative Environment Programme (SACEP), and the South Pacific Regional Environment Programme (SPREP). The Economic and Social Commission for Asia and the Pacific (ESCAP), with assistance from members of the Interagency Committee on Environment and Sustainable Development, prepares regular regional State of the Environment (SoE) reports every five years. At the regional level, the Environment Law Programme of UNEP in the Asia-Pacific region has been significantly intensified since early 1996. Current activities focus on technical advice and assistance at the request of Governments in the region, specifically to strengthen national environmental legislation to implement environmental conventions. Nonetheless, the level of participation by the developing countries of Asia and the Pacific in international agreements is relatively modest, in most cases because of inadequate resources and a marked lack of technical and administrative expertise. Some welcome sub-regional initiatives since GEO-1 are the ASEAN Regional Haze Action Plan, South Asia Declaration (termed as "Male Declaration" - See Box 3.2) on control of air pollution, and establishment of Acid Deposition Monitoring Network in East Asia.

The July 1993 Meeting of the ASEAN Senior Officials on the Environment (ASOEN) (representing Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore and Thailand) agreed to develop a new ASEAN Strategic Plan of Action on the Environment (1994-1998) with various objectives. Environmental cooperation within ASEAN is wide-ranging and serves as a model for other regional organizations. Recently ASEAN has been expanded to include Cambodia, Lao PDR, Myanmar and Viet Nam. The South Asia Cooperative Environment Programme (covering Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka and the Islamic Republic of Iran) continues to implement an action plan known as the SACEP Strategy and Programme (1992-1996). This covers a number of key areas including capacity building and awareness raising; systematic information exchange and intra-regional technology transfer; training on environmental management and institutional development; regional cooperation in the management of mountain ecosystems, watersheds and coastal resources; and wildlife and wildlife habitat conservation (SACEP 1992). The South Pacific Regional Environmental Programme, established in 1993, covers 22 Pacific Island countries and territories and aims to enhance institutional capacity. It implemented an action plan for 1991-95, a regional strategy covering many aspects of environmental assessment, management and law within the sub-region. SPREP has initiated also an Action Plan for Managing the Environment of the South Pacific Region (1997-2000).

The Mekong River Commission (representing Cambodia, Lao PDR, Viet Nam and Thailand, with China as observer) is an inter-governmental organization responsible for cooperation and coordination in the use and development of the water resources of the Lower Mekong Basin. In 1991, an Environment Unit was established within the Technical Support Division to deal with the environmental issues in this sub-region. The International Centre for Integrated Mountain Development (representing Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan), which was established in Nepal in 1983, continues to implement its different programmes to attain environmental stability and sustainability in mountain

Box 3.2: Malé Declaration

South Asian Governments approved the Malé Declaration on Control and Prevention of Air Pollution at SACEP's 7th Governing Council Meeting held on 22nd April 1998 in Malé, Maldives. The Declaration encourages intergovernmental cooperation to address the increasing threat of transboundary air pollution and its impacts. Besides laying down the general principles of intergovernmental cooperation for air pollution abatement, the Declaration includes plans for an institutional framework linking scientific research and policy formulation. It also calls for the continuation of this process in stages, with mutual consultation, to draw up and implement national and regional action plans and protocols based on a fuller understanding of transboundary air pollution issues. In addition a follow-up action plan will be implemented at the national, sub-regional and regional levels to strengthen the implementation of the Declaration.

Source: SACEP, 1998

ecosystems and the eradication of poverty in the Hindu Kush-Himalayas.

Transboundary pollution has attracted significant regional cooperation. For instance, since 1993 the Environment Agency of Japan has begun advocating the establishment of an Acid Deposition Monitoring Network in East Asia to create a common understanding of the state of acid deposition and to provide useful inputs for decision making at all levels. This monitoring network will bring together eight collaborating countries (China, Indonesia, Japan, Korea, Malaysia, Mongolia, Philippines, Thailand) and the Russian Federation to establish uniform monitoring techniques, share data and information, conduct a common base of understanding, and facilitate international cooperation (EA, 1997a). Similarly, the Northwest Pacific Action Plan, adopted in 1994, deals with regional data collection, survey of national legislation, and marine pollution monitoring, preparedness and response (O'Conner, D. 1996). The ASEAN Cooperation Plan on Transboundary Pollution, adopted in June 1995, is an outstanding example of focused sub-regional cooperation. It covers the three programme areas of transboundary atmospheric pollution, transboundary shipborne pollution and transboundary movements of hazardous wastes. In line with this Cooperation Plan, ASEAN has also adopted and vigorously implemented the Regional Haze Action Plan 1997 to deal with the haze problem.

The two key features of trade policy in the Asia-Pacific region are first, the widespread unilateral trade liberalization in many countries and second, the efforts at greater regional economic integration. One of the greatest regional policy challenges of the decade is to promote liberal trade yet maintain and strengthen the protection of the environment and natural resources. Trade and investment have been the principal engines of rapid economic growth, which has contributed to environmental degradation. A number of governments are now taking action to reconcile trade and environmental interests, through the growing use of trade and environment related policies and agreements, such as product standards, enforcement of the polluter pays principle, health and sanitary standards related to food exports, and eco-labeling. A significant number of countries are also signatories to international environmental agreements with trade implications, such as the Montreal Protocol on Substances that Deplete the Ozone Layer, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, and the Convention on Trade in Endangered Species. ASEAN has recognized that trade is an important instrument to promote sustainable development and that any measures to promote better environmental management must be consistent with the General Agreement on Tariffs and Trade (GATT) principles. Therefore, ASEAN has called for trade arrangements that are supportive of environment and development policies and has sought to improve capacity in trade-environment policy analysis, planning and evaluation (ASEAN, 1997).

3.4 ECONOMIC INSTRUMENTS

Incentives and disincentives are now both used as economic instruments to promote environmental conservation and efficient resource use throughout the region. Incentives include preferential tax credits and accelerated depreciation allowances on pollution abatement and control equipment. For example, tax deductions stimulated the installation of industrial anti-pollution equipment in the Philippines and the Republic of Korea, while in India an investment allowance of 35percent, compared with the general rate of 25percent, is provided towards the cost of new machinery and plant for pollution control or environment protection (Government of India 1992).

Disincentives are based largely on the polluter pays principle, which calls for the costs of environmental pollution to be reflected in prices. This is now widely recognized in much of the legislation. Pollution fines are commonplace, for example in the Philippines, where fines to complement the enforcement of emission standards are based on the duration of the violation (days), present environmental conditions, quantity of discharged effluent, and average deviation from the effluent or emission standards (Government of the Philippines, 1992). A number of deposit-refund schemes have been promoted to encourage recycling and reuse of products, especially packaging materials. For instance, under a scheme in the Republic of Korea, manufacturers and importers of various goods are required to deposit funds with the government to cover the costs of waste recovery and treatment (Government of Republic of Korea 1991). Similarly, a number of countries in the region, among them Japan, Malaysia, Republic of Korea, Singapore and Thailand, have introduced some form of eco-labeling schemes to ensure that consumer products are manufactured by environmentally sound processes and to promote awareness among consumers to the environmental aspects of consumption patterns (MoE, Singapore).

Environment funds of varying degree and scope are established in many countries, like the US$200 million

environment fund recently established by the Government of Thailand to clean-up cities and control industrial pollution (ESCAP 1995). In the Philippines, two mining companies acting on orders from the government have created an Environmental Guarantee Fund to rehabilitate and restore areas adversely affected by mining operations. A Reforestation Fund is also proposed as part of a scheme to counter the denudation of forest cover (Government of the Philippines 1992). An example of market, policy and institutional failures is the degradation of Asia's forest (See Box 3.3).

Box 3.3: Degradation of Asia's Forest Cover - An Example of Market, Policy and Institutional Failures

The degradation of Asia's forests is an example of market, policy and institutional failures. Explicit and implicit subsidies and volume-based taxes on timber removal encourage destructive logging, especially of marginal and fragile forestlands. Forest concessions are typically too short to provide incentives for conservation and replanting. When concessions are awarded, the goods and services that forests provide other than timber are rarely priced. This results in excessive deforestation and in conflicts between logging companies and local communities. The lack of secure property rights, both of agricultural lands and often of forest resources, aggravates deforestation. Without secure land tenure, people do not invest in soil conservation practices and, as it becomes difficult to maintain agricultural yields on existing land, people clear new lands from the edges of forests.

Source: ADB, 1997.

South Asia still sets greater reliance on regulatory mechanisms than on market forces to achieve environment policy objectives. Property rights, especially in water and forests, remain ill defined and insecure despite efforts to decentralize decision making to local levels. There are, however, some successful examples of price mechanisms influencing the more efficient use of water by the industrial sector, for example in India (World Bank/UNDP, 1995). There is a growing awareness too of the importance of pricing resources such as water to better reflect its economic value and social cost. However, caution must be exercised with regard to property rights being created for water and forest with a view to protecting the interest of the poor and prevent commercial interest from taking over.

In contrast, environmental policy in the ASEAN region is shifting from a reliance on command and control towards the use of economic instruments, some of which have been in use for more than a decade. In Malaysia, discharge fees have been in use since 1978 to complement a regulatory approach towards solving water pollution from palm oil mills (Panayotou, 1994). With the gradual imposition of more stringent standards and higher discharge fees, biochemical oxygen demand (BOD) in public water bodies dropped steadily from 222 tons per day in 1978 to 58 tons in 1980, and to 5 tons in 1984 (Government of Malaysia 1994). In Thailand, a combination of economic incentives and command and control measures is used to address air pollution in Bangkok. Economic instruments have also been introduced indirectly by privatizing public sector activities, for example the provision of sewerage in Malaysia. In Singapore, road pricing was introduced in the early 1970s to reduce road congestion. Highly effective area licensing schemes were adopted which, by charging drivers who use the roads in the city center during peak hours, reduced congestion significantly during peak hours. This system has been further improved by automation via the Electronic Road Pricing (ERP) System (Panayotou, T. 1994). In 1990, Singapore introduced a vehicle quota system to further control the growth of private vehicles whereby anybody wishing to own a car had to bid for a Certificate of Entitlement (O'Conner, D. 1996 and MoE, Singapore, 1998). In a quite different sector, Malaysia has implemented tax exemptions for investment in timber plantations to complement efforts in sustainable timber production (Government of Malaysia, 1994). Another success story is the GEF funded Demand-side Management Programme in the power sector of Thailand (See Box 3.4).

Among the GMS countries, Thailand and Vietnam have made limited use of economic instruments to stimulate sound environmental conservation while Cambodia, Lao PDR and Myanmar remain committed to command and control approaches. Thailand has been highly innovative and has subsidized capital investment of the treatment of hazardous waste and toxic chemicals, implemented service charge on community wastewater treatment, implemented price differentiation between leaded and unleaded gasoline, and considered granting community rights to conserve forest (Government of Thailand, 1992). Vietnam is also trying to use some economic instruments such as resource pricing (for urban environment) and environmental charges (for atmosphere).

Among the Northwest Pacific and East Asian countries, most economic instruments are used in combination with command and control regulations. Japan and the Republic of Korea have both adopted the polluter pays principle as an important policy instrument, although in Japan the principle is yet to be

Box 3.4: Demand-Side Management in Power Sector of Thailand

Recognizing the severe impacts of accelerated energy demand, the Thai government has adopted a comprehensive Demand-side Management (DSM) Plan for the power sector. In 1992, a five-year (1993-1997) DSM Master Plan was formulated and implemented with a total budget of US$ 189 million. By the end of October 1997, the DSM programs resulted in saving 295 MW of peak demand and 1,564 GWh of electrical energy. The estimated level of carbon dioxide (CO2) emission avoided from the power sector through the DSM programs was 1,166,854 tons while the investment requirement in power generation was reduced by US$ 295 million. The programs also resulted in consumer savings of US$ 100 million in terms of electricity bills.

Switching of the lamp production from fat tubes (40 W and 20 W) to slim tubes (36 W and 18 W) was one of the most successful DSM programs in the country. A public campaign was undertaken through mass media with a budget of US$ 5.0 million. Electricity Generating Authority of Thailand (EGAT) promoted the use of compact fluorescent lamps (CFLs) instead of incandescent lamps by procuring the CFLs at prices lower than in the market through bulk-purchase with competitive bidding. The CFLs were then sold through selected retailers at a price lower than the market price.

Under another DSM program (called "Green Building Program"), commercial buildings could obtain CFLs at subsidized price. The program emphasized on energy savings in both existing and new buildings. For existing buildings, EGAT carried out energy audit, design and retrofitting of electrical systems to comply with the energy efficiency requirements set by the government. EGAT provided interest-free loans (repayable on a monthly basis in a period of 3 years) to the owners of both existing and new buildings for the purpose. There was also a program under which fluorescent lamps for rural street lighting were replaced with subsidized high-pressure sodium vapor lamps.

There was a promotional campaign for labeling of refrigerators. Refrigerators in the market were subjected to tests for the purpose of efficiency labeling. Similarly, air-conditioners were also tested for efficiency labeling. Users of air-conditioners could get interest-free loans of US$ 125 or US$ 250 (repayable within 20 months) to purchase efficient air-conditioners depending upon the efficiency labels. There was also a program under which EGAT encouraged manufacturers/importers of electric motor to produce/import high efficiency motors and for industrials to use high efficiency motors by providing interest-free loans (repayable within 3 years) to meet the additional cost associated with the switch to high efficiency motors.

Source: Adapted from EGAT, Demand-side Management in Thailand: Experience and Perspectives, EGAT, Bangkok, Thailand, 1997.

applied comprehensively to pollution control because of existing systems of financial subsidies and tax credits (IDE, 1995). Mongolia is trying to move from a top-down, command and control approach to one with increased public participation and is relying on traditional patterns of resource use, enhanced by economic incentives and user-pay principles (JEA, 1994).

China, too, is paying increasing attention to the role that economic instruments can play in achieving environmental protection targets. A wide range of economic and environmental policies are undergoing reform to adapt to the needs for efficient environmental management under a more open market economy. China has been also introducing several economic instruments such as pollution charges, pricing policy, favorable terms of investment for environmental technology, market creation, as well as ecological compensation fees. In the coming decade, China aims to incorporate natural resources and environment values into the accounting system of its national economy and establish a pricing system that reflects environmental costs (Government of China 1997).

Economic and fiscal instruments are being developed, promoted and supported for many areas of pollution prevention and sustainable natural resource use in Australia. For example, the pricing and conditions required to ensure sustainable use of energy, water and other natural resources, including the removal of subsidies to resource use, are being implemented (Environment Australia GEO-2 Input, 1998). In New Zealand, the only fully developed example of an economic instrument at present is in fisheries management where an Individually Transferable Quota (ITQ) system is used to manage the major fisheries. Under this system, annual catch limits are set by central government on the basis of scientific advice and stakeholder submissions. The best-known economic instruments, i.e., the deposit-refund schemes that once operated for soft drink, beer and milk bottles, disappeared in the 1980s as the growth of supermarkets and centralized distribution centres favoured plastic containers over glass ones. In the early 1990s, a system of tradeable permits was introduced to regulate imports of ozone-depleting substances, and a tax on leaded petrol was introduced to promote the use of unleaded petrol. However, in both cases, the economic instruments were only transitional measures. Since 1996 CFC imports and leaded petrol have been phased out. In general, economic instruments are not widely used in New Zealand to achieve environmental outcomes. Regulation is generally seen as more effective and

straightforward. It is also often seen as fairer because the same rules apply to everyone, rich or poor. On issues where regulation is not popular, councils generally prefer to use public education rather than fees or subsidies to affect behavioural change. Nevertheless, interest in economic instruments is increasing (New Zealand GEO-2 Input, 1998).

3.5 CLEANER PRODUCTION PROCESSES AND TECHNOLOGIES

Industry groups in both low- and high-income countries of the Asia-Pacific region have shown an increasing sensitivity to environmental concerns over industrial production. Waste minimization, energy efficiency, waste recycling and substitute CFC programmes are among the many industrial initiatives now being undertaken. Japan is leading the way in both actively pursuing policies to encourage cleaner production and in developing the required new technologies. While the environmental audit is not yet common, some pioneering businesses have already adopted the practice. Major equipment manufacturers in Japan have come out with a package of environmental control and audit standards to prevent pollution since the 1970s (ESCAP 1995). In Malaysia, a system of environmental audit has been drawn up by the Ministry of Science, Technology, and Environment. In India, the Ministry of Environment and Forests issued in 1992 a notification to audit stocks of raw materials, outputs, generated wastes, methods of waste disposal, and the environmental impacts of the industry on its surroundings (CSE, India, 1994).

To increase market share, a number of companies in South Asia have tried to develop a green image by promoting environment-friendly products and allocating a proportion of their profits to environmental conservation activities. The Indian government has prepared "ECOMARK" criteria for 14 product categories, including soap and detergents, paper, paints, plastics, lubricating oil, aerosols, food items, packaging materials, wood substitutes, textiles, cosmetics, electrical and electronic goods, food additives and batteries (Government of India, 1992). There are also emerging partnerships between governments and the private sector to provide environmental services and infrastructure. The National Environmental Engineering Research Institute (NEERI) is developing a wide range of environmental technologies to improve pollutant monitoring, the recycling and management of urban and industrial solid wastes, EIA analysis, water treatment and environmental support programmes for rural development (Government of India, 1992). Similarly, an environment-friendly insecticide has been developed based on the neem seed. Unlike most chemical pesticides this is harmless to both humans and the environment (but not to insects). In order to encourage industries to adopt methods of production that generate less waste and fewer emissions, the Government of India issued a gazette notification on environment audit on 13 March 1992, which was subsequently amended on 22 April 1993. The notification requires that an Environmental Statement be submitted in stipulated time to the concerned State Pollution Control Board. In this Statement, industries are required to provide information on the water and raw material consumption, pollution generated, hazardous wastes and solid wastes along with the disposal practices. The industries are also asked to specify the impact of pollution control measures on conservation of natural resources (Government of India, 1993).

ASEAN is well aware of the importance of clean technology in supporting environmental management. The strong participation in and adoption of ISO 9000 and the even more aggressive participation of the ASEAN countries in the ISO 14000 standards for manufacturing reflect this trend. National organizations to certify the ISO 14000 standards have been established in Malaysia, Singapore and Thailand, while the Philippines is adopting ISO 14000 standards as part of national standards (Philippine Council for Sustainable Development, 1996). Environmental auditing and environmental labeling are being promoted in a number of countries to promote cleaner production processes and new technologies. In Indonesia, timber certification and eco-labeling are used as instruments to attain sustainable forest management (Government of Indonesia, 1995) while in Singapore some 29 product categories are listed under the Green Labeling Scheme (Government of Singapore, 1998). In Thailand, the financial support required to encourage both private and public sectors to develop cleaner production processes and adopt environmentally friendly technologies is provided by an Environmental Fund established for this purpose, while in Indonesia the government, acting through the Environmental Impact Management Agency, provides assistance to factories to develop cleaner and less polluting technologies (Government of Indonesia, 1995).

Cleaner production is not yet a feature in most GSM countries, except perhaps in Thailand where the textile, pulp and paper, electroplating, chemical and food

industries are all involved in promoting cleaner production initiatives. Reports by the Federation of Thai Industries (FTI) and Thailand Environment Institute (TEI) indicate that cleaner production is having a significant impact in terms of minimizing waste and pollution as well as promoting cooperation between government and industries, and among the industries themselves (Thailand Environment Institute, 1996).

In the Northeast Pacific and East Asia region, the Japanese industry leads the way to cleaner production (See Box 3.5). The private sector finances some 60percent of all research and development into environmental technology and contributes heavily to funding a number of government research agencies. A survey of 144 major Japanese firms in 1991 found that 88percent had already established environmental divisions (ESCAP, 1995). The Japanese industry is particularly strong in "end-of-pipe" technology and clean motor vehicle technology, and in some clean energy fields such as photovoltaics and fuel cells. Nine of Japan's largest steel makers are involved in a project to increase the use of scrap metal in steel manufacture, and the Japan Automobile Manufacturers Association has set standards for making vehicle parts in plastic for easy recycling. Consumer cooperatives have become a powerful force in Japan to popularize green products (ESCAP, 1995) while local governments have progressively provided technological and financial support to small and medium sized companies. In the Republic of Korea, the 1994 Act for Promoting Environmentally Friendly Production Systems and the Environmentally Friendly Plant Certification System encourage the adoption of environmentally friendly production systems and production processes (Government of Korea Rep. 1994 & 1997).

Box 3.5: Japan - Leading the Way to a Cleaner Future

Japan enforces the world's most stringent standards for automobile exhaust emissions, as well as very strict standards to control smoke emissions from factories and other facilities. As a result of these standards and the investments made to develop desulfurization systems, denitrification processes and other air pollution control technologies, Japan has attained visible success in reducing atmospheric SO_2 and CO_2 emission levels. However, the NO_x concentrations began to increase in the late 1980s due to the increase in traffic and diesel-powered vehicles.

In addition, discharges of hazardous substances into freshwater bodies have been drastically reduced by the implementation of water management policies based on national environmental quality standards, and more stringent standards imposed by prefectural or local authorities, as well as by voluntary agreements with industry. The legal system for water quality management now involves authorities at the national, prefectural and municipal level. However, it is necessary to investigate new emerging pollutants and to implement appropriate policy measures in order to prevent new health damages.

Source: NIES GEO-2 Input, 1998

Cleaner production in China has been introduced to 51 enterprises in 11 industries on an experimental basis while in the chemical, metallurgical, machine tools, power generation and construction industries a system of elimination is being applied to get rid of products that are manufactured using the old "smokestack technology." By June of 1997, some 64,000 enterprises with heavy pollutant emissions had either been eliminated, closed for refurbishment or halted production (SEPA 1997). At the same time, the petrochemical industry has succeeded in substantially reducing atmospheric $C0_2$ emissions (by five million tons). Furthermore, in an effort to fulfill its obligations under the Montreal Protocol, China is eliminating products and processes that produce ozone depleting substances. Seven enterprises that produce refrigerators for home use now market the so-called green refrigerators that bear a national environmental hallmark. More specific initiatives of China with regard to controlling industrial pollution are given in Box 3.6.

In Australia, the draft National Strategy for Cleaner Production examines and promotes activities to encourage the implementation of cleaner production. Over 30 completed case studies of cleaner production across a broad range of Australian and New Zealand Standard Industrial Classification (ANZSIC) divisions have been studied and reported (Environment Australia Website). The draft strategy recommends measures to be pursued by all levels of the Australian community, drawing on Australian and overseas examples. The National Pollutant Inventory (NPI), established under the 1996 National Environment Protection Act, aims to produce a public database detailing the types and amounts of certain toxic chemicals entering different areas of the Australian environment (Environment Australia, GEO-2 Input, 1998).

Similarly, cleaner production is actively fostered by some government agencies in New Zealand. The Energy Efficiency and Conservation Authority (EECA) gives advice to industries and local authorities, and encourages the adoption of energy efficiency and use of renewable energy through loans, voluntary agreements and annual awards. The Ministry for the Environment helps develop guidelines for cleaner

Box 3.6: Controlling Industrial Pollution in China

China has implemented numerous policies to improve the state of the country's water resources with the result that industrial pollution has significantly decreased and, in particular, heavy metal pollution from industrial workshops, which used to constitute a major pollution problem, no longer affects the water environment. For example, as part of the Three Rivers and Three Lakes water control project - covering the Huaihe, Haihe and Liaohe rivers and Lakes Taihu, Dianchi and Chaohu - an Interim Regulation for Controlling Water Pollution along the Huaihe River was formulated to treat river pollution. This was one of the seven largest water basin programmes in China. By 1997, when the programme ended, several thousand small enterprises that used to discharge heavy pollutants had been closed down, upgraded their technology or transferred production to clean products, and water quality in the river had improved substantially.

In addition, since 1997, China has defined, delineated, and demarcated those areas of the country most affected by SO_2 and acid rain and has actively pursued policies to decrease atmospheric pollution, particularly of smoke and dust, and to build up smoke control areas. These policies include the imposition of SO_2 emission fees and the introduction of clean-burning technologies in order to increase efficiency. The main obstacles are the lack of adequate capital and technology necessary for changing the present energy structure.

Source: SEPA-China GEO-2 Input, 1998

production and publishes case studies showing examples of energy efficiency and waste reduction techniques in different sectors (e.g. reusing heated water and other waste products, installing long-life bulbs, reusing towels, and others) (Ministry for the Environment, 1997). The government also encourages cleaner production by entering into accords with industries (e.g. to limit carbon emissions and packaging waste), helping set up an eco-labeling scheme, and funding environmental research and development projects. The national eco-label, "Environmental Choice", was launched in 1991, in the midst of the economic recession. By the end of 1997, six years after its launch, three companies had the Environmental Choice label: Feltex Carpets, and the paint manufacturers, Levene and Resene (New Zealand GEO-2 Input, 1998).

3.6 NATIONAL AND INTERNATIONAL FINANCE AND CAPITAL FLOWS

In most of the countries of the region the annual domestic investment in the environmental sectors is increasing. A major thrust, particularly among developing countries, is on water supply, waste reduction and waste recycling. Bilateral and multilateral aid is a significant source of environmental investment and expertise. While public sector investments in water, sewerage, and waste disposal infrastructures have been growing in the industrializing countries, private sector spending and investment remain significantly lower. And even if private sector investment in pollution abatement increases dramatically, bilateral and multilateral aid will remain a significant source of environmental investment. For example, in 1993 the Asian Development Bank provided loans related to environmental improvement and natural resources management of US$1.6 billion and by 1994 its cumulative environmental lending totaled US$6.3 billion. A large portion of these loans were aimed at improving energy and industrial efficiency, water supply and sanitation facilities, afforestation, and marine and coastal resources management. Indonesia, Philippines, India, Pakistan, and Thailand received the major share of the lending for environment-oriented projects (Jalal, 1994). An Asia Sustainable Growth Fund, sponsored by the Asian Development Bank, has been established to raise US$150 million as source of long-term capital for environmentally sound companies in the developing countries of the Pacific Rim (UNCSD, 1995).

The ASEAN countries have benefited significantly from official development assistance (ODA) for environmental projects through bilateral and multilateral agreements and from capital mobilized from various sources including the OECD, ADB, World Bank and international financial markets. The private sector in the ASEAN region has played an increasingly important role in forging economic development, especially with the gradual reduction in ODA contributions, and its role in resource and environmental management is likely to expand with the introduction of economic instruments, third party monitoring and auditing, and the privatization of environmental management systems. This requires huge investments. ADB estimated that ASEAN requires more than US$6 billion additional investment to protect the environment from industrial pollution. In total, the region will need more than US$72 billion additional investment in environmental protection during the period (ADB, 1994 cited in ASEAN, 1997). The mobilization of financial resources

for effective environmental protection will be therefore a major challenge for ASEAN countries in the next decade.

Japan is the largest source of project-related development assistance in the Northwest Pacific and East Asia, providing some US$779 million in 1991 for investment in the human environment, anti-pollution measures and disaster prevention. In 1992, Japan announced that environmental aid would be increased to US$7.1 billion over the next five years, and a Green Aid Plan of 300 billion Yen over a 10-year period would be made available to transfer pollution control technologies to developing countries and to support joint R&D projects on the global environment (UNCSD 1995). In 1992, its first year of operation, some $20 million were released, half for development assistance and half for financing environmental technology transfer from Japanese companies. Another notable example is the Japan Fund for Global Environment (see Box 3.7), an initiative of the Environment Agency of Japan.

The Republic of Korea's Official Development Assistance (ODA), which is provided by the Economic Development Cooperation Fund and the Korea International Cooperation Agency, exceeded US $ 520 million in 1996. Republic of Korea has sponsored potable water supply system and waste water system improvement projects in several countries. It acceded to the Global Environmental Facility in 1994 and contributed $5.6 million during 1995-97. Although the environmental component of development aid remains limited, Republic of Korea intends to expand it by increasing financial assistance for environmental facilities, such as water supply and sanitation (Government of Korea Rep. 1997).

According to Commonwealth of Australia (1998), Australia's official development assistance (ODA) amounted to approximately A$1,440 million in 1997-98. Australia's ODA to GNP ratio in 1997-98 was 0.27 percent, above the weighted average of 0.25 percent for other OECD donor nations. Australia's aid programme is administered by the Australian Agency for International Development (AusAID). About two-thirds are designated for country and regional assistance

Box 3.7: The Japan Fund for Global Environment

The Japan Fund for Global Environment was established within the Japan Environment Cooperation (JEC) in May 1993 with a view to extending financial, information, educational, and training assistance to nongovernmental organizations (NGOs) inside and outside Japan. The fund was endowed not only by the National Government but also by citizens, corporations, and other donors. The total endowment of the Japan Fund for Global Environment was 7,098,780,000 Yen as of 31 December 1996. It provides funding from the interest earned for such projects as mentioned below.

1. Assistance for environmental conservation activities of private organizations

a) Environmental conservation activities in developing countries by private organizations whose principal places of business are situated in Japan.

b) Environmental conservation activities in developing countries by private organizations whose principal places of business are situated outside Japan.

c) Environmental conservation activities inside Japan by private organizations whose principal places of business are situated in the country.

2. Dissemination of information necessary for promoting activities of private organizations as well as education and training, etc.

a) Studies on the state of environmental NGOs, dissemination of information by means of computerized communications mainly to them, as well as educational and training activities for the public and NGO staff members.

b) Activities under the Global Partnership Programme. Inaugurated in 1997, the Programme hosts NGO forums held in conjunction with inter-governmental conferences, to help organize a worldwide network of NGOs and to foster partnership among countries in the Asia-Pacific region for environmental conservation activities

Source: Environment Agency of Japan, 1997

for poverty reduction and economic development projects and one-third for multilateral, humanitarian and NGO assistance. Several countries in the Asia-Pacific region were recipients of AusAID funds. In 1997-98, Papua New Guinea (A$319.2 million), Indonesia (A$88.9 million), Vietnam (A$66 million), Philippines (A$56.7 million), China ($A53.5 million) Bangladesh ($A33.3 million), Cambodia ($32.1 million) and Thailand ($22.5 million) were among those that received assistance of over A$20 million (Environment Australia GEO-2 Input, 1998).

Since the economic reforms of the 1980s, New Zealand has had no restrictions on the flow of capital in or out of the country. As of 1996, New Zealand was a net investment debtor, with foreign investment in the country nearly four times greater than New Zealand's investment overseas. Much of this investment was in real estate, natural resources and infrastructure. The communications and public transport industries are now largely foreign-owned, as are the banks, finance companies and most large shopping chains. Foreign investors have also purchased forest cutting rights, fishing quota, and gold mining rights. Investment in new capital goods fell in the early 1990s during the recession but rose by 62 percent between 1992 and 1996 (New Zealand GEO-2 Input, 1998).

3.7 VOLUNTARY ACTION AND PUBLIC PARTICIPATION

Non-Governmental Organizations (NGOs) at local, national, and regional levels have emerged as major players and partners in development and conservation activities, performing a multitude of roles including education and environmental awareness raising among the public. These NGOs have assisted in the design and implementation of environmental policies and programmes and have played crucial advocacy roles through their environmental campaigns. NGOs, while retaining their individual identity, have collaborated with national and local governments on a wide range of issues and concerns and often government-NGO cooperation has achieved more effective results. NGO networks are springing up throughout the Asia-Pacific region to promote common concerns and interests in environment and development. Among the most prominent at the regional level are the Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC) and the Asia Pacific People's Environment Network (APPEN). These last few years have witnessed the rise of powerful people's movements in different countries of the Asia-Pacific region, many of them linked to environmental issues ranging from the forest peoples of Malaysia to those threatened by the Narmada dam in India. In the Philippines, a consortium of 17 environmental NGOs (NGOs for Protected Areas, Inc.) was given a US$27 million grant to implement a seven-year Comprehensive Priority Protected Areas Programme. The programme is a major component of the World Bank-GEF Sectoral Adjustment Loan initiative being managed by the Department of Environment and Natural Resources (Umali, NEDA, Philippines). Children, youth, women, and indigenous people are all making significant impacts on environmental conservation both through their individual activities or as part of NGO coalitions.

There is also remarkable public participation and voluntary action in South Asia. In Sri Lanka, for instance, NGOs have been active in preventing logging of the Singharaja Forest, in setting up a Tiger-top lodge in Udawala National Park, in stopping the construction of a thermal plant at Trincomalee, and in questioning the blind implementation of the National Forestry Master Plan (Government of Sri Lanka, 1994). NGOs have also been involved in the preparation of the National Environmental Action Plans as well as the setting out of specifications for ElAs, which serve as key instruments for environmental management. Similarly, in India thousands of NGOs have played a vital role in raising awareness on issues related to environment and development, and mobilizing people to take action. The Narmada Bachao Andolan has brought together scattered voices of protest against the damming of the river Narmada and has raised awareness both in India and among the international community (Government of India, 1992). Another effective means of advocacy that NGOs in India have adopted is people's tribunals on key environment and development issues. For instance, the Permanent People's Tribunal (PPT) entertains cases filed by individuals or communities affected by environmental degradation. The PPT hears the case and its judgments are delivered and widely publicized (South-South Solidarity, 1992). Another trend with regard to public participation has been the growing importance of community-based systems of natural resource management.

ASEAN countries have encouraged public participation in many aspects of environmental management, and local government and local community-based groups and NGOs have been actively cooperating in resource and environmental management at the local level. In Thailand, the Environment Act of 1992 delegates the work on environmental management to provincial and local

authorities and encourages people's participation through environmental NGOs (Government of Thailand, 1992). Thailand's 1997 Constitution recognizes the rights of people to participate in the protection of natural resources and environment (Government of Thailand, 1997). In the Philippines, small fishing communities are given the right to manage their fishery resources (Panayotou, 1994; PCSD, 1996). Community-based forest resource management has also shown positive results in protecting and conserving forest resources in the Philippines (Umali, NEDA, Philippines). Similarly, many coastal community groups in Thailand actively protect mangroves and seagrass (OEPP, 1997). A partnership mechanism in Indonesia has been developed between the government, the private sector and local communities for environment planning and development (Government of Indonesia, 1995) while in some ASEAN countries community participation is mandated by law. For example, the new forest law and the new water law in Thailand specifically recognize the property rights of local communities.

Voluntary actions have played an important role in environmental protection in Northwest Pacific and East Asia region, especially in Japan where local communities, citizen's groups and government together take the initiative to negotiate with major polluters. The Japan Federation of Economic Organizations adopted the Keidaren's Global Environmental Charter in 1991, which includes a provision that companies should carry out environmental impact assessments of their activities, utilize and develop low pollution technologies, and actively participate in local conservation programs (OECD 1994). Several Japanese companies have initiated voluntary actions resulting in agreements about pollution control, most of which contain stricter standards than the national ones. For example, the beer industries promote recycling through a voluntary deposit-refund system for bottles and cases. Industries in the Republic of Korea are preparing to adopt the ISO 14000 environmental management system and some companies have already come up with their own internal environmental audit (OECD 1997). Japanese companies have also watched the development of the ISO 14000 very closely and many of them are now planning to obtain the ISO 14001 registration, which they see as essential if they are to compete effectively in the international market (OECD 1994).

The Japan Fund for Global Environment was established in 1993 to support NGOs by providing information, training and financial resources. The Ministry of the Environment in Republic of Korea is trying to involve the public in the policy formulation process through regular meetings and hearings with communities and NGOs. Today the Korean Federation Environmental Movement in the Republic of Korea provides an umbrella organization for the almost 200 NGOs (including 84 registered at a local level) engaged in activities related to environmental issues while in 1987 the government established an Environmental Watchdog System to raise awareness and encourage self-monitoring of environmental pollution (Government of Korea Rep., 1994). Similarly, in Mongolia the people take an active part in promoting measures to protect their wildlife. Several NGOs in Mongolia are involved with training, carry out reviews, submit suggestions and recommendations concerning environmental protection, provide information to the public, and implement conservation projects. The government cooperates closely with NGOs, for example, with the Mongolian Association for the Conservation of Nature and Environment, which coordinates the voluntary activities of local communities and individuals to protect nature and wildlife, and with the Green Movement, which promotes public environmental education in support of traditional protection methods (MNE, UNDP, WWF, 1996). In the case of China, the government has been long aware that public participation is an essential prerequisite for successful environmental protection and management (see Box 3.8).

In Australia, approximately 70 percent of people surveyed in 1992, 1994 and 1996 were concerned about environmental problems, rating air pollution, followed by ocean and freshwater pollution and vegetation clearing as the prime concerns (Commonwealth of Australia, 1998). Landcare is a community-based approach to address natural resource management problems and protect agriculture resources, e.g., tree planting projects on upper catchment properties. Landcare also assists natural resource managers to improve their technical, management, communication and planning skills. About one-third of Australian farmers are members of a Landcare group (Government of Australia Website). The Coastcare programme provides opportunities for communities to work with local land managers to identify problems along their stretch of the coast and develop and implement solutions. Coastcare has formed 250 community groups since its inception in early 1996 (Government of Australia Website). The Endangered Species Programme administers public networks such as the Threatened Species Network and Threatened Bird Network, to promote active community involvement in recovery programmes for threatened species (Government of Australia Website). Recently, the Commonwealth Department of the Environment (Environment Australia) has been working with the

Box 3.8: Women's participation in environmental protection in China

In China, the government has issued the "Law on the Protection of Women's Interest and Rights of the People's Republic of China" and established the Committee in charge of the Work of Women and Children under the State Council in 1993. The State Council in turn issued the "Development Program of Chinese Women" in 1995. All these developments have ensured the protection of Chinese women's right and position of participation in national management and decision-making. Statistics show that women account for about one third of the total number of those involved in environmental education, and communication. Moreover, women are playing more and more important roles in environmental decision-making and management. In most provincial and municipal environmental protection bureaus, at least one of the directors for each bureau is a woman, and many other leading cadres belong to women as well. For instance, in Shandong Province during 1994, the cadres in the field of environmental protection in the whole province was over 5,400, among which some 1,670 were women, accounting for almost 30 percent.

In the rural areas, women farmers have built over 60,000 "green bases" like orchards that have developed the economy and protected the environment. Women have also organized many environment-related activities, such as promoting firewood-efficient stoves, accumulating farm manure, reducing the use of chemical fertilizers, and the like. In poverty-stricken areas, women have also played important roles in afforestation and ecological protection. For example, in Guizhou Province, during 1990 and 1993, women established 221 "Women greening project" demonstration sites covering an area of 570,000 mu; 408 economy bases of forest products and fruits covering an area of 64,000 mu; 6,309 forest lands with women as the main force covering an area of 533,000 mu; and 460 professional afforestation teams consisting of 23,230 women. Even the Tibetan women have constructed 592 "women greening projects" and planted over one million trees.

[Note: 15 mu = 1 hectare]

Source: SEPA-China GEO-2 Input, 1998

ALGA to develop State of the Environment indicators that can be applied by local environmental managers and are consistent with indicators used at the State and national scales. This project also emphasizes the potential of community groups to provide data that are relevant to local managers (Environment Australia GEO-2 Input, 1998).

A key feature of the Resource Management Act of New Zealand is its detailed public participation process. In developing the ten-year policies and plans, regional and district councils are required to consult widely with community stakeholders and interest groups, including the local indigenous people, the Maori. Once a policy or plan has been prepared, it must be released in draft form for public comment and hearings, and then modified accordingly. Citizens who still object to elements of the final policy or plan are free to appeal to a special purpose tribunal, the Environment Court, which may order further changes. Surveys in the early 1990s showed that a third to half the population had signed environmental petitions and donated money to environmental causes. Around 5 percent of the population had written letters on environmental issues and 4 percent had participated in protest actions of some sort (Colmar Brunton, 1990 and 1993; Gendall et al, 1994). The main participation problem for environmental and community groups is the cost involved. Often they lack the resources for research or legal advice (New Zealand GEO-2 Input, 1998).

3.8 ENVIRONMENTAL INFORMATION AND EDUCATION

The information base is relatively weak in most countries of the region and a number of international agencies, including the ADB, UNDP, ESCAP, UN Statistical Institute for Asia-Pacific and the Environment Assessment Programme of UNEP, are actively involved in strengthening institutional capacities to manage environmental information. Standardization of databases and data sources (GIS and remote sensing) to support environmental assessment, reporting, research and decision-making are being actively pursued. The Environment Agency of Japan has initiated ECO Asia Net (see Box 3.9) to promote information exchange throughout the region. The Asia-Pacific Network for Global Change Research (APN), an inter-governmental network with a secretariat based at the Environment Agency of Japan, has been created to support a range of activities such as: cooperating in global change research on issues particularly relevant to the region; standardizing, collecting, analyzing and exchanging scientific data; improving scientific and technical capabilities and research infrastructure of countries in the region; cooperating with research networks in other regions; providing scientific knowledge to the public and input to decision makers; and developing appropriate mechanisms for transfer of know-how and technology (APN, 1997; Environment Agency of Japan).

The Environment Assessment Programme for Asia-Pacific (EAP-AP) of UNEP has initiated a number of activities over the last three years, focusing primarily on: institutional capacity building and servicing; database development and management; and assistance to Asia-Pacific countries in preparing national and sub-regional State of the Environment reports.

In almost all countries of the region there are public education and awareness programmes that seek to educate and sensitize people to environmental issues and problems. However, the development of environmental education has been concentrated at the primary and secondary levels with preschool and tertiary levels receiving less attention. Also relatively little effort has been directed towards policy and decision makers in the region, particularly those concerned with resource use and resource allocation at senior government level. NGOs have played a key role in producing print and audio-visual materials for non-formal environmental education in schools and other institutions of learning. For instance, in India, the Centre for Environmental Education has produced a wide range of books and audio-visual packages for the benefit of both teachers and students (Center for Environmental Education (CEE), 1995), while some television programmes have been very successful in raising environmental awareness at all levels and in drawing attention to the illegal poaching of tigers, rhinos, and other endangered species (MoE, India). There has been considerable interest in integrating environmental concepts into adult education and literacy programmes. For example, the Asian-South Pacific Bureau of Adult Education (ASPBAE) established a network of environmental educators in 1992 (Asian-South Pacific Bureau of Adult Education (ASPBAE) 1992). Other educational programmes focus on issues of general scientific and conservation interest. For example, UNEP along with SACEP and SPREP, has been promoting public awareness on marine conservation issues as part of the Regional Seas Programme.

The Asia-Pacific Network for Tertiary Level Environmental Training (NETTLAP) of UNEP is a good example of regional cooperation for environmental education and training. NETTLAP focuses on enhancing the environmental expertise of decision makers, policy formulators and tertiary level trainers by establishing a self-sustaining network of trained individuals. Besides developing and applying

Box 3.9: Eco Asia Net for the Exchange of Environmental Information

The Environment Agency of Japan organized Eco Asia (Environment Congress for Asia and the Pacific) in 1991 to promote informal dialogue among environment ministers in Asia and the Pacific.

Eco Asia'96 held in May 1996 saw participation from many parties, including 12 environment ministers, 20 senior governmental officials and 10 representatives from international organizations. This congress discussed the Long-Term Perspective Project on Environment and Development in Asia and the Pacific to identify policy options for sustainable development, looking towards the environment in 2025; the Asia Pacific Environmental Information Network Project (ECO NET) for the development of an environmental information network utilizing the Internet; and the Junior Eco-Club Activities to enhance environmental awareness among children and to promote environmental conservation activities.

The Long-Term Perspective Project on Environment and Development in the Asia-Pacific Region has proposed the following four concepts:

(a) Eco-Consciousness: Environmental awareness such as environmentally-friendly values, traditions and social activities should be rediscovered, and mutually respected and maintained in Asia and the Pacific.

(b) Eco-Partnership: Cross-boundary multi-sectoral partnerships linking governments, private sectors, NGOs and local authorities should be strengthened.

(c) Eco-Technology and Eco-investment: In periods of advanced economic growth, active environmental investment and introduction of environmental technologies by the private sector should be promoted.

(d) Eco-Policy Linkage: Policies to address global environmental problems should be linked with domestic environmental policies in each country.

Source: Environment Agency of Japan (1997c); Environmental Cooperation Programme in Asia and the Pacific towards Sustainable Development (ECO-PAC), June 1997, Japan

innovative methods in environmental training, NETTLAP identifies regional needs and shares knowledge through ongoing interaction between network partners. Through its Training and Resources Development Workshops, NETTLAP prepares and disseminates curriculum guidelines, resource materials, learning aids and packages for environmental training. The network with its National Focal Points, regional Thematic Network Coordinators and sub-regional Thematic Network Nodes, has grown rapidly over the last two years. It now covers 35 countries in the region, with over 200 tertiary institutional members, and 2000 individual members (UNEP-ROAP, 1998).

An increasing number of newspapers in the region have started addressing the subject of environment and related issues. Until a few years ago, reporting on environment was limited to reports of speeches on Environment Day or covering tree-planting campaigns. But today journalists, working closely with environmental activists, are much more proactive and are focusing on larger issues on a much wider scale.

Environmental education became fully integrated into the school curricula of South Asian countries (except Nepal) in the 1970s when environmental studies were first introduced as a subject of study (UNESCO-ROAP, 1992). Environmental journalism is on the rise in many countries resulting in a significant increase in media coverage of environmental issues. In Sri Lanka, the number of news items and editorials on the environment and sustainable development has grown rapidly over the last decade (Government of Sri Lanka 1994) while in India the single issue of large dams has dominated media coverage of environment since the 1990s. Apart from dam projects, issues of nuclear power, forestry, land degradation and water all feature in Indian media coverage on the environment. The government Environmental Information System Network (ENVIS) is a notable example of the collection, collation, storage, analysis, exchange, and dissemination of environmental data and information (Government of India, 1995).

In its strategic plan, ASEAN has outlined the steps necessary to strengthen the knowledge base on environmental matters and sustainable development. The region has promoted activities to strengthen the role of major groups in sustainable development, including support to publishing environmental magazines and newsletters. Countries in the region have introduced environmental education in the formal education system at all levels. Many countries also utilize the informal education centers as means for environmental education. For instance, Indonesia has promoted environmental consciousness through its Environmental Study Centres (UNESCO-PROAP, 1998). Central government support to raise environmental awareness is provided in Malaysia through the Department of Environment, and in Thailand through the Department of Environmental Quality Promotion. It is expected that ASEAN countries will continue to promote environmental information flow and education into the future to further enhance public participation in environmental management and decision-making, especially through local communities, local governments and NGOs.

Information on environmental problems and possible solutions to them is generally inadequate in the GMS region, particularly in Cambodia, Lao PDR and Myanmar, and this shortage of reliable data and data analysis capabilities undoubtedly hinders policy development, planning and program implementation. There is a need not just for more data on environmental issues, but for standardizing data collection and storage, and making it accessible to both technical and management levels. Data of poor quality are often reused and recycled for studies and plans, which are then accepted without proper scrutiny. The lack of baseline socio-economic data has also been identified as a serious constraint, and even where sufficient data exist there is no established mechanism for access or interchange. To address these problems, the Asian Development Bank and UNEP, in close collaboration with the Mekong River Commission, has been implementing a Sub-regional Environmental Information and Monitoring System (SEMIS) project with the objective to enhance the availability and accessibility of environmental and natural resources data to national government agencies and regional organizations and also to establish a mechanism that will allow sharing of all these information in a timely manner (ADB/UNEP/MRC, 1996). In Myanmar, non-formal education plays an important role in promoting public environmental awareness although formal environmental education is gradually being introduced at the tertiary level. The National Commission for Environmental Affairs (NCEA) of Myanmar has been instrumental in promoting public environmental education and awareness in the country since its establishment in 1990 (NCEA, Myanmar, 1998).

In Northwest Pacific and East Asia, the environmental information base in Japan and the Republic of Korea is significantly strong. The Republic of Korea is the first country to have a Law for Public Information (1996) and the government is now regularly publishing several environmental indicators such as water and air quality levels. Government also

distributes a White Paper on the Environment to some 160 private organizations and is issuing a monthly Environmental Information bulletin (OECD 1997). The Japanese Environmental Agency also publishes an annual White Paper on the Environment and many other books and pamphlets for wide dissemination. However, environmental education in Japanese schools is voluntary and so differs from school to school. Both the Environment Agency and the Ministry of Education promote popular environmental education by producing television programmes and films, holding seminars on environmental education and distributing teaching material (EA, 1997).

With a technical assistance loan from the World Bank, China has set up an environmental information system in each of its 27 provinces and autonomous regions (SEPA, 1996). Environmental protection has found its way into primary and secondary education, and over 140 institutions of higher learning and over one hundred secondary schools and intermediate professional and vocational schools have set up environment departments and other relevant special courses. These include 206 undergraduate level special courses, 223 Masters Degree courses, 77 Doctoral programmes and several Post-doctoral programmes (SEPA-China GEO-2 Input, 1998). Radio stations regularly broadcast programmes and conduct competitions on environment themes, one local radio station in Beijing attracting (in 1988) over 60,000 responses from over one million listeners to a knowledge competition on environmental protection, a success that has since been repeated by other radio stations (Chaoran and Changhua, 1993).

Australia has adopted SoE reporting as a mechanism for public education on environmental matters. For instance, Environment Australia has sold approximately 8,000 copies of the 1996 SoE report (Commonwealth of Australia, 1996) to the Australian public, and over 4,000 schools have received complimentary copies of the SoE reporting education kit. Considerable effort also goes into research and the collection of data relevant to environmental issues in Australia. According to the Commonwealth of Australia (1996), the non-business sector (e.g. universities and government agencies) spent about 4,500 person-years of effort and more than A$320 million on environmental research and development. Additionally, there is the significant research spending of the private sector and the prodigious efforts of voluntary groups. Much research effort is being expended in two areas: natural ecosystems, mainly in the universities, and the environmental aspects of primary industry, mainly conducted by State and Commonwealth government agencies and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (CSIRO Website). New programmes are also being developed by the Australian government to monitor and report on sets of environmental indicators. For instance, Environment Australia is currently managing the development of a set of scientifically credible indicators for national SoE reporting on several themes. These themes are biodiversity, estuaries and the sea, inland waters, the land, atmosphere, human environment and natural and cultural heritage. Detailed indicator reports will become available on the web for each of these themes during the course of 1998 (ERIN Website). In addition, these national indicators are being used as guide for the development of SoE indicators within States and Territories through the ANZECC SoE Taskforce.

Australia is increasingly using the Internet to promote information exchange and availability among the scientific community, the Government and the public (Commonwealth of Australia 1996). Most national and state institutions with an interest in environment issues have either developed or are planning to develop websites. An instructive example is the extensive database of information, incorporating access to numerous scientific and environmental databases that is provided by the Commonwealth's environmental Website "Environment Australia On-line" and is maintained by the Environmental Resources and Information Network (ERIN) (http://www.erin.gov.au). The databases include: the Greenhouse Gas Inventory, EnviroNET Australia, National Pollution Inventory, the National Wilderness Inventory and the Blue Pages - the Marine and Coastal Data Directory. The Australia and New Zealand Land and Information Council (ANZLIC) is the peak body for coordinating the development of a national spatial data infrastructure on geographic and marine themes for Australia and New Zealand. This will include a national directory to help users search the Internet to find data sets through standardized meta-data storage and retrieval techniques (ANZLIC Website).

There are several other relevant programmes presently underway that are aimed at improving the extent and range of environmental data in Australia. These include: the implementation of the National Strategy for the Conservation of Biological Diversity, the work of the National Environmental Protection Council, the Australian Biological Resources Study, the National Marine Information System, the wide-ranging work of the Australian Bureau of Statistics, the establishment of a National Wastes Database through Commonwealth funding, the National Pollutant Inventory, the work of the Montreal Process

Implementation Group for Australia (MIG) on Montreal Process criteria and indicators for forest management, the National Collaborative Project on Indicators for Sustainable Management (NCPISA) - a Standing Committee on Agriculture and Resource Management (SCARM) initiative, and the recently developed national Land and Water Audit - which is being funded under the NHT.

Australia is also applying modeling techniques using environmental data to indicate areas of high environmental value as part of resource planning exercises, to predict the distributions of various species whose habitat overlaps with areas of high forestry potential, and to forecast local weather and climate change. Australia's predictive ability in these areas is affected by continued access to satellite data, the 'state of the art' of its supercomputers, and the rigor of its weather monitoring network. The National Resource Information Centre (NRIC), which is part of the Department of Primary Industries and Energy (DPIE) analyses national sustainable development issues, such as drought, land degradation, hazardous waste and multiple land use through computer modeling and visualizations of these issues for use by policy makers (Environment Australia GEO-2 Input, 1998). Some impressive achievements appear in ecosystem monitoring by satellite imaging. Remote sensing data are becoming increasingly available for use by Commonwealth, State and Territory environmental agencies for use in a wide variety of projects. These data include NOAA-AVHRR data, Landsat MSS and Landsat TM data. Key indicators of environmental condition such as the rate of land clearing, siltation of rivers and the health of coral reefs are being monitored through remote sensing in Australia (Government of Australia Website).

New Zealand has been slow to develop good information systems with regular monitoring and reporting of local and national environmental conditions (OECD, 1996; Ministry for the Environment, 1997). This failure to develop good information systems is partly attributable to the dispersed nature of environmental responsibility. Monitoring by regional councils is slowly improving. The Ministry for the Environment has recognized the need for some standardized national information and is working now to develop eleven core sets of national environmental indicators. The Ministry has also produced the country's first national report on the state of the environment (Ministry for the Environment, 1997).

3.9 SOCIAL POLICIES

While there is little evidence of specific environmental policies targeted at addressing concerns over equity or poverty, the region has seen some policy initiatives in the social sector. The thrust of these policies has been to address poverty directly through employment generation programs and to improving equity through rural credit, while many countries have adopted policies to stabilizing or moderating population growth rates. The success of efforts directly targeted at alleviating poverty has varied, with notable progress being made in East Asia, and less so in South Asia (ESCAP, 1995). The direct support programmes set up by many Asian governments provide subsidized food or credit and introduce micro-finance programmes. Subsidy programmes have typically not worked well. Subsidized food deliveries are not easy to target, and the deliveries have often gone largely to the better off in urban areas. Subsidized credit programmes have been less effective because the loans typically fail to reach the poor, are often used for consumption, and are usually not repaid (ADB, 1997). Examples of such social policies in South Asia include the Nutritious Food Program and Food For Work Program in Nepal, and the Integrated Rural Development Program in India.

Social policies of ASEAN countries have emphasized the promotion of sustainable human settlements. Basic needs of the rural population, especially shelter and safe drinking water, have been the priority targets. Human resource development has also been emphasized, with high priority on education and training (ASEAN, 1997). Social policies have also supported the process of decentralization of resources and environmental management. ASEAN has recognized the environmental impacts of development, urbanization and rapid population growth on social development. The spread of HIV-AIDS and increasingly severe air and water pollution are the emerging issues to be given priority in social development. ASEAN has spelled out the need to support the development of a regional framework for integrating environment and development concerns in the decision making process. For instance, in Indonesia, rural development has focused upon sustainable uses of resources, especially land and water. In Thailand, capacity building of local people, through participatory training, has been emphasized in upper watershed areas to ensure their sustainable uses of natural resources. In the Philippines, national urban policy has been formulated to provide a macro perspective of urban development in addressing equity issues, management systems, institutional and organization frameworks and environment (PCSD, 1996).

Over the past decade, the Chinese government has implemented a series of policies on science and education, population, women and social protection in the interest of environmental protection. In recent years, both central and local governments have stepped up efforts to relieve the victims of natural disasters. In 1995, relief funds amounted to 2.35 billion Yuan, benefiting over 31 million poverty-stricken people. A further seven million households received relief funds from local government organizations while some two million households were able to shake off poverty (Government of China, 1997; SEPA-China GEO-2 Contribution, 1998).

In New Zealand, the trend is generally towards less government involvement in service provision and more emphasis on individual self-reliance. Families, the voluntary sector and local people are now being called on to play a larger role in dealing with social problems. For instance, this process of shifting responsibility from government to private individuals is promoted through phrases like "community care", "the code of social responsibility", "strengthening families" and "building social cohesion" (New Zealand GEO-2 Input, 1998).

3.10 REGIONAL MULTILATERAL ENVIRONMENTAL AGREEMENTS

Regional Multilateral Environmental Agreements (MEAs) are concerned with the shared resources of the region or sub-region. In the Asia Pacific region there are a number of sub-regional agreements for the protection and proper management of these rich and shared resources. Figure 3.1 shows countries signatory to major environment conventions till 1st March 1999 in 5 subregions and Asia and the Pacific region as a whole . The status of acceptance of regional MEAs is shown in Table 3.2. It shows that there are many sub-regional MEAs among groups of countries covering various areas of interest to participating governments. However, except for the bilateral agreements, the level of implementation of the regional MEAs is very low.

3.10.1 Trends and Level of Implementation

Awareness building and public information are relatively strong for several regional MEAs because the countries

Figure 3.1: Parties to major environment conventions (as at 1 March 1999)

Source: GEO 2000

concerned share and manage the same resources. It seems that the narrower the membership spectrum of the agreement, the wider is the coverage in the local mass media. For example, it has been observed that the Ganges Water Sharing Treaty is known even to the poor farmers in some of the remotest parts of Bangladesh and West Bengal in India. Similarly, the Indus Water Treaty between India and Pakistan is widely known among the parties concerned and has worked effectively despite many other unresolved issues between the two countries.

As in the case of global MEAs, the formal legal adoption and implementation of most regional MEAs has been quite slow. The pace of implementation depends largely on the political will of the government, which, in turn, is controlled by the direct effect on the public of non-compliance with the MEA. While no separate national institutions have been created from these agreements, there is usually a secretariat for each agreement located in the offices of the relevant international organization, such as FAO and ASEAN, or in the Foreign Ministries of individual member countries. The national agencies are responsible for the implementation of the agreements. For example, in the case of the Ganges Water Sharing Treaty, the Bangladesh Water Development Board (BWDB) is the concerned institution and two signatory countries, India and Bangladesh, have set up a Joint River Commission. In the case of plant protection, the responsible body in many countries is the forestry department.

Several countries that are party to some regional MEAs are now considering various incentives in terms of subsidies and tax reduction, as well as, penalties as possible mechanisms for promoting compliance. In this regard, the assistance of the relevant national agencies are sought to insure effective imposition of sanctions. For example, national bodies entrusted with the conservation of forests (under Plant Protection Agreement) provide needed assistance and impose punishment for cutting wood in the classified areas. In the case of bilateral projects, reporting compliance is mandatory and is carried out by designated agencies. However, this is not the case for other types of agreements.

Post-signing developments have been mostly issue-based, with atmosphere, water and wildlife receiving the most attention. For instance, regions that are prone to natural disasters and calamities have developed their own strategies to reduce pollution and protect wildlife independent of the regional MEAs. But the regional MEAs tend to reinforce the actions of planners and decision-makers at the national level. However, because of lack of resources, expertise and sometimes even political will, the post-signing stages of regional MEAs are rarely completed and not embodied in national legislation.

3.10.2 Barriers to Implementation

As with global MEAs, the urgent need to implement regional MEAs is not often recognized by the country's decision-makers. In the light of other urgent national needs, they find it difficult to give these MEAs priority attention. Budgetary limitations are also severely restricting much needed human resource development and capacity building.

The linkages between the regional MEAs are also not clear. More work is needed to identify the additional benefits that may result from the simultaneous implementation of several MEAs. Concerted efforts are needed to increase awareness among the legislators, executives and judiciary and the public on the adverse consequences of the non-implementation of the MEAs. Unless people realize these serious consequences, it will be difficult to secure the priority attention needed to promote effective implementation.

The lack of accepted indicators for assessing the impacts of regional MEAs also hinders implementation. Because of this, the impacts of MEAs cannot be properly evaluated and the task of convincing decision-makers of their importance becomes very difficult. When conflicting interests are involved, lack of means for assessment often leads to non-implementation or delay. In general, it is hard to identify the positive effects of regional MEAs, and both the government and non-government agencies responsible for implementing these MEAs need immediate strengthening in order for them to generate public support for their efforts. Table 3.2 shows the status of various MEAs.

3.10.3 Items for policy action

In order to remove or minimize the various barriers to implementation the following policy actions should be considered:

- Building up of institutions and human resources in local agencies, government and NGOs;
- Securing external financial support to supplement national funds;
- Enhancing collaboration between government, NGOs, private sector and other partners;
- Developing indicators for impact assessment;

Table 3.2 - Status of Regional MEAs in Asia and the Pacific

Regional MEAs	Number of Countries accepting it	Date of entry into force	Membership Status
Plant Protection Agreement for Asia and Pacific Region	26	2.7.56 16.8.69 16.2.83 23.5.90	Open to any state of the region or government responsible for international relation of any territory
Convention on Conservation	6	28.6.90	Open to state members or eligible to be of Nature in the South Pacific invited to become members of the South Pacific Commission
South Pacific Nuclear Zone Treaty	12	11.12.86	Open to the member states of the South Pacific Forum
ASEAN Agreement on the Conservation of Nature and Natural Resources	6	Not yet	Open to member states of ASEAN
Convention for the Protection of the Natural Resource and Environment of the South Pacific Region	15	22.8.90	Open to states invited to participate in Noumea Conference, 24-25 November, 1986
Agreement on the Network of Aquaculture Centre in Asia and the Pacific	13	11.1.90	Open to states invited to participate in the Conference of plenipotentiaries
Convention for the Conservation of Southern Bluefin Tuna	3	20.5.94	Open to Australia, Japan and New Zealand and other states whose vessels engage in fishing and coastal states through whose zones tuna migrates
Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin	4	5.4.95	Open to Cambodia, Lao PDR, Thailand and Vietnam and to other riparian states with the consent of the above parties
Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region (The WAIGANI Convention)	14	Not yet	Open to the members of the South Pacific Forum and to non-members having territories in South Pacific region
Ganges Water Sharing Treaty	2	5.11.77 12.12.96	Bilateral Treaty Between Bangladesh and India
Integrated Development of Mahakali River	2	29.1.96	Bilateral Treaty between India and Nepal
Indus Water Treaty	2	19.9.60	Bilateral Treaty between India and Pakistan

- Encouraging bilateral agreements with multiple benefits;
- Developing national expertise in environmental governance;
- Promoting exchanges of experts on MEAs in the region;
- Costing the effects of no action and making them known.

In all these activities, it is useful to work in national languages, using national experts reinforced with international expertise, in order to reach a wider cross-section of local officials and the public on these issues.

REFERENCES

ADB (1990). Economic Policies for Sustainable Development, Asian Development Bank, Manila

ADB (1997). Emerging Asia: Changes and Challenges, Asian Development Bank, Manila

ADB/UNEP/MRC (1996). Sub-regional Environmental Monitoring and Information System (SEMIS)- Project Implementation Document, TA. No. 5562-REG, Asian Development Bank, March 1996

ASEAN (1995a). ASEAN Cooperation Plan on Transboundary Pollution, ASEAN Secretariat, Jakarta

ASEAN (1997). First ASEAN State of the Environment Report, ASEAN Secretariat, Jakarta

Asia-Pacific Network for Global Change Research (APN) (1997).

APN Home Page: http://www.rim.or.jp/apn

Asia-South Pacific Bureau of Adult Education (ASPBAE) (1992). ASPBAE Environmental Education Newsletter. Issue No. 1, Quezon City, Philippines

Center for Environmental Education (CEE) (1995). Environmental Education in Asia: Regional Report for the UNESCO Inter-regional Workshop on Reorienting Environmental Education for Sustainable Development, Ahmedabad

Chaoran, Yu and Changhua, Wu (1993). Environmental Education and the Media's Role in China, a paper presented at the SASEANEE Workshop in Ahmedabad, February 1993

CoAG (1992). National Strategy for Ecologically Sustainable Development, Council of Australian Governments. AGPS, Canberra, Australia

Colmar Brunton (1990). Project Green, report prepared for the Ministry for the Environment, Colmar Brunton Research Ltd, Auckland

Colmar Brunton (1993). Project Green, second report prepared for the Ministry for the Environment, Colmar Brunton Research Ltd, Auckland

Commonwealth of Australia (1996). Australia: State of the Environment 1996, CSIRO Publishing. Collingwood, Australia

Commonwealth of Australia (1998). 1998 Year Book Australia, Australian Bureau of Statistics. Canberra, Australia

CSE (1994). Down to Earth, Vol 2. No.24. May 1994, Centre for Science and Environment. New Delhi. India.

EA (1994). The Basic Environmental Plan, Environment Agency, Government of Japan

EA (1997). Quality of the Environment in Japan, in Japanese.

EA (1997a). Acid Deposition Monitoring Network in East Asia - Achievements of Expert Meeting, March 1997, Environment Agency, Government of Japan

EA (1997b). Japan's Environment Protection Policy, Environment Agency, Government of Japan

EA (1997c). Environmental Cooperation Programme in Asia and the Pacific Towards Sustainable Development (ECO-PAC), June 1997, Japan

ESCAP (1995). State of the Environment in Asia and the Pacific, UN-ESCAP, Bangkok, Thailand

Global Environmental Outlook 2000

Gendall, P.J., Hosie, J.E. and Russell (1994). International Social Survey Programme: The Environment, Department of Marketing, Massey University, Palmerston North

Government of Bangladesh (1994). Country Presentation of Bangladesh, Regional Meeting on the State of the Environment in Asia and the Pacific, Myanmar

Government of China (1997). The People's Republic of China, National Report on Sustainable Development, SEPA, Beijing, China

Government of India (1992). Environment and Development: Traditions, Concerns and Efforts in India, UNCED Report, New Delhi

Government of India (1992). National Report to UNCED, Ministry of Environment and Forests. India

Government of India (1993). Environment Statement - As Part of Environmental Audit, Ministry of Environment and Forests, India, 5 June 1993.

Government of India (1995). Annual Report 1994-95, Ministry of Environment and Forest. New Delhi. India

Government of Indonesia (1995). Indonesian Country Report on Implementation of Agenda 21, The State Ministry of Environment, Republic of Indonesia

Government of Republic of Korea (1991). National Report of the Republic of Korea to UNCED, Ministry of Environment. Seoul

Government of Korea Rep. (1994). MoE 1994, Environmental Protection in Korea, Ministry of Environment (MoE), Government of Korea Republic

Government of Korea Rep. (1997). MoE 1997, Environmental Protection in Korea, Ministry of Environment (MoE), Government of Korea Republic

Government of Malaysia (1994). Report to the United Nations Commission on Sustainable Development, Malaysia, Ministry of Science, Technology and the Environment, Kuala Lumpur, Malaysia

Government of Nepal (1994). National State of the Environment, Nepal, prepared for submission to SACEP, Colombo, Sri Lanka

Government of the Philippines (1992). A Report on Philippine Environment and Development, Department of Environment and Natural Resources, Quezon City

Government of Singapore (1992). The Singapore Green Plan: Towards a Model Green City, Ministry of the Environment, Singapore

Government of Singapore (1998). Make Green Label Your Choice, pamphlet printed by Ministry of the Environment, Singapore

Government of Sri Lanka (1994). State of the Environment of Sri Lanka, Ministry of Environment and Parliamentary Affairs, Colombo, for Submission to the SACEP, Colombo, Sri Lanka

Government of Thailand (1992). The Enhancement and Conservation of National Environmental Quality Act B.E. 2535, Thailand

Government of Thailand (1997). Constitution of the Royal Thai Kingdom, Thailand

IGES (1997). Current Environmental Issues and Strategic Research in the Asia-Pacific Region

IDE (1997). IDE Spot Survey. Institute of Developing Economies

JEA (1994). Environmental Governance in the Pacific Century, edited by J.E. Nickum and J.R. Nishioka, Japan Environment Association, East-West Center

Jalal, Kazi F. (1994). Environment Investment Financing: The Role of the Asian Development Bank, Manila

Jinfa, L. (994). China Combats Desertification, Our Planet, Vol. 6, No. 5, UNEP, Nairobi

MNE/UNDP/WWF (1996). Mongolia's Wild Heritage, Ministry of Nature and Environment, Mongolia, Ulaanbaatar

MRC/UNEP (1997). Mekong River Basin Diagnostic Study: Final Report, Mekong River Commission. Bangkok, Thailand

Ministry for the Environment (1997). The State of New Zealand's Environment 1997, GP Publications, Wellington, New Zealand

NEPA (1993). China Environment News, 8 December 1993, National Environmental Protection Agency

NCEA (1997). Myanmar Agenda 21, Chapter 19, page 195-196, National Commission for Environmental Affairs (NCEA), Yangon, Myanmar

OECD (1994). OECD Environmental Performance Reviews: Japan. Paris, France

OECD (1996). Environmental Performance Reviews: New Zealand, Organization for Economic Cooperation and Development, Paris

OECD (1997). Environmental Performance Reviews: Korea

OEPP (1997). National Action Plan for Environmental Quality Promotion (in Thai), Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment

Philippine Council for Sustainable Development (1996). Onwards from Rio: Continuing Philippine Efforts in Sustainable Development, Philippines

SACEP (1992). SACEP Strategy and Programme I (1992-96), SACEP, Colombo, Sri Lanka

SACEP (1998). Male Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia, report of 7th SACEP Governing Council Meeting held on 22nd April 1998 in Male, Maldives

SEPA (1996). China Environment Yearbook in 1996, SEPA, Beijing, China

SEPA (1997). China Environment Yearbook in 1997, SEPA, Beijing, China

SEPA (1997). Report on the State of the Environment in China 1997, SEPA, Beijing, China

South-South Solidarity (1992). South Link Newsletter, Vol II, No. ii-iii, July- October, New Delhi

Thailand Environment Institute (1996). Towards Environmental Sustainability, Annual Report, Bangkok, Thailand

UNCSD (1995). Financing the Transfer of Environmentally Sound Technology, United Nations Commission on Sustainable Development, January 1995

UNEP (1994). Our Planet, Vol. 6, No. 5, UNEP, Nairobi

UNEP (2000). Global Environment Outlook 2000, Earthscan, London

UNESCO-PROAP (1992). Final Report of Training Workshop in Environmental Education for Elementary Teacher Educators for South Asian Countries, Bangkok, Thailand

UNESCO-PROAP (1988). Environmental Education at University Level, report of a Seminar on the Strategy for Inclusion of Environmental Education at University Level, Yogyakarta, 20 June- 4 July 1987, Bangkok

World Bank/UNDP (1995). Water Conservation and Reallocation: Best Practices in Improving Economic Efficiency and Environmental Quality, A World Bank - ODI Joint Study by Ramesh Bhatia, Rita Cessti and James Winpenny

CHAPTER 4

Outlook and Recommendations

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Outlook and Recommendations

4.1 INTRODUCTION

Asia and the Pacific region are expected to witness a rapid economic growth in the next two decades, fueled by industrialization, trade and investment. Rapid economic growth is expected to improve the living standards of the people, but there are major concerns with its possible negative impacts on environment and social conditions. The present trend of economic development in the region has put enormous pressure on environment in the form of water shortage, air and water pollution, depletion of natural resources, biodiversity loss and depletion of forests, and land degradation. The result may be irreversible ecosystem damage with far-reaching implications for forestry, agriculture, fisheries and tourism. Increasing pressure from burgeoning population growth, liberal economic policy and land use change could threaten the region's environment and rich natural resources. All these might lead to serious problem of food security, human health, riot on water, and could enhance potential of natural disasters.

There is an express need to reverse the trend of environmental and social conditions through framing appropriate policy measures at the national, subregional and regional levels, and making determined efforts on implementations. Political will, strong partnership between government, business and civil society, and cooperation at the subregional and regional level could bring about the desired changes on ground. The region holds a great opportunity with its vast natural resources such as agriculture land, water resources, coastal and marine resources, mineral resources, and rich biodiversity. Improved governance and policy initiatives could help in exploiting the positive effects of globalization in order to make the Asia-Pacific region economically sustainable, environmentally sound and socially equitable.

4.2 FUTURE ENVIRONMENTAL SCENARIO

4.2.1 Land

As agricultural production increases more slowly than in the past, the region will increasingly rely on imported food. By 2010 Asia's share of world cereal imports may rise to about 42 percent from its current level of 33 percent (ADB, 1997), and this may put pressure on world food balances and affect world food prices. Food security will continue to be a high priority in most countries of the region particularly in parts of East and South Asia (ESCAP, 1995). The limiting factor in meeting the challenge of producing more food will be supplies of fresh water, especially in populous and arid areas.

In South Asia, structural adjustment programmes, including trade liberalization and the removal of subsidies from forest products as well as some food and cash crops, will encourage renewable intensive production and increased exports (Dutta and Rao, 1996). This pattern of growth in agribusiness is likely to place an increasing strain on the region's rural production resources unless there are changes in agricultural practices and environmental regulations.

In Southeast Asia, the rapid transition from an agricultural to an industrial economy over the past two decades has reduced the pressure on agricultural land use to some extent. In the Mekong region, soil productivity is expected to continue its decline with increasing intensive agricultural practices (MRC/UNEP, 1997a).

In East Asia, agricultural or forest land is likely to continue to be replaced by human settlement and industries. Increasing use of agrochemicals in some countries in the region will further aggravate soil degradation as can be observed already in Korea DPR.

In China, the conflict between increasing population and decreasing agricultural land looks set to continue. At present, China is basically self-reliant for grain supply.

Projections of China's grain situation in some recent studies vary widely. Compared to the projection of the World Watch Institute, studies by the World Bank, the International Food Policy Research Institute, the Food and Agriculture Organization of United Nations, official China sources, and most recently, the U.S. Department of Agriculture all project a substantially smaller cereal trade imbalance for China (Goldman, 1997).

Since about 20 percent of Australia is highly prone to erosion, overgrazing and excessive cultivation will likely further accelerate soil erosion. On sloping lands, water erosion poses a threat to the long-term sustainability of farming in those areas. Acid soils also occur extensively in Australia, due to the overuse of fertilizers and legume-based pastures, as well as natural weathering. Acidic soils (pH < 6.5) cover an area of 93 million hectares. More than 30 million hectares in the higher rainfall cropping and pasture zones have severely acidic soils (pH < 5.5). Acidification can lead to toxic soils, poorer water and nutrient uptake by plants and thus, reduced yields (SCARM, 1998). Salinity problems are expected to worsen in Australia. Already some 2.5 million hectares are currently subject to salinization primarily due to rising groundwater tables resulting from irrigation. About one-third of Victoria's irrigation area, for example, has been salinized to date (Commonwealth of Australia, 1996). It is expected that about one-quarter of the cleared land in southwest Western Australia will become salinized over the next few decades, and dryland salinity will also expand in the eastern uplands of Victoria, New South Wales and Queensland. If present trends continue, 5 million hectares in the Murray-Darling Basin alone will be subject to salinization by 2020 (SCARM, 1998).

In New Zealand, if current trends of land use continue over the next decade, the following developments will occur: soil problems associated with intensive use, such as soil compaction and stream bank collapse will increase as dairying expands; urban expansion into fertile farmland will continue in the upper North Island and around the perimeters of large cities; hill country erosion will lessen as sheep are replaced by trees in steep pasture land; and chemical contamination of soil will decline as existing contaminated sites are identified and cleaned up, and as new laws and industry practices reduce the use and unsafe disposal of harmful substances. At the same time, food is likely to remain abundant, though some low-income households may experience increasing difficulty ensuring regular access to it (New Zealand GEO-2 Input, 1998).

Action Plan

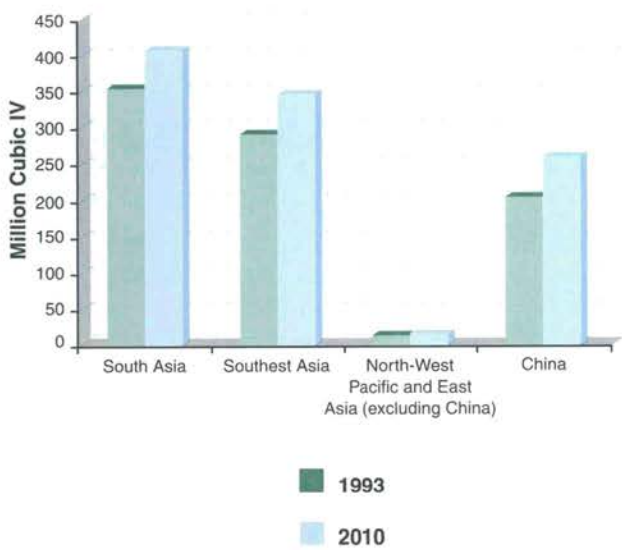
With roughly 58 percent of the world's population depending upon only a quarter of the world's land area, there is tremendous and increasing pressure on land resources to provide basic needs to the region's fast expanding population. Unsustainable land-use practices including expansion of agriculture into marginal lands, the overuse of agro-chemicals, mismanagement of irrigation, and unplanned urbanization must be controlled urgently in order to stop and reverse any further land degradation. The region's major challenge is to optimize the land-use for competing needs. The actions proposed to reverse the trend of land degradation (MCED, 2000) included:

- Introduce policy reforms for effective and efficient management of land and water resources. Develop guidelines and implement integrated land and water management projects.
- Formulate or review National Action Plans for combating desertification and land degradation. Prepare National Action Plan on food security. Integrate socioeconomic dimension into National Action Plan to deal with the consequence of drought and desertification. Provide training and awareness on National Action Plan to pursue effective implementation.
- Assessment of the extent of land degradation and desertification at national and regional levels. Prepare a database on the land degradation. Prepare soil erosion risk maps at the national level. Develop institutional capacity at the national level to carry out assessment of land degradation and desertification. Regional cooperation on improved tools and techniques on the assessment and data management.
- Networking and information sharing at the national and regional level on improved irrigation techniques and pest management. Demonstrate projects on sustainable agriculture and good water shed management.
- Technical cooperation at the national and regional level for desertification control action plan and drought mitigation strategies. Technical support also for early establishment and operationalization of the Convention to Combat Desertification. (CCD).
- Develop strong partnership between government, business and civil society in activities related to management and control of land degradation and desertification. Promote awareness and training programme to address issues of land degradation and desertification.

4.2.2 *Forests*

Asia's dominance of the world trade of tropical hardwoods is likely to decline by the end of the century because of the depletion of timber reserves and increased domestic wood consumption as presented in Figure 4.1. Domestic wood shortages are already beginning to appear among several timber producers in Asia, most notably in the Philippines, Thailand and South Asia. At current rates of harvesting, the remaining timber reserves in Asia will last for less than 40 years (ADB, 1994b) and an area of about 50 million hectares may well be deforested by 2005 (Rao, 1994). Deforestation will further aggravate the widespread incidence of desertification, soil erosion, siltation, flooding and biodiversity loss (ADB, 1997) and will be a major contributor to drought and climate change in the region (Ali, 1994). And continued development of urban and industrial infrastructure into forested areas will increase opportunities for forest exploitation by providing easy access for logging and encroachment (EA, 1997a).

Figure 4.1: Projected Wood Consumption, Asia-Pacific, 1993-2010



Source: FAO (1995a) and FAO (1997b)

In South Asia, the liberalization of economic and trade policies, and the absence of adequate development of alternative energy sources are intensifying pressure on forest resources and contributing to ecological degradation. In Nepal, for instance, soil erosion accelerated by deforestation is now raising concern as a major cause of river silting and consequent flooding (Sharma, 1993). The large-scale removal of tree cover in the sub-continent will be a major contributor to unprecedented floods, drought and climatic change (Ali, 1994).

In Southeast Asia, reforestation efforts are likely to be intensified but it remains to be seen whether this will catch up with the rate of deforestation. This may slow down but will continue into the next century, as commercial forests remain an important source of export income. The sustainable forest and agricultural management policies that were introduced in the 1990s will continue to be implemented and may show more results. However, shifting cultivation will continue to pose a threat to watersheds throughout the sub-region as tribal peoples who still rely on the system have been forced to adopt shorter and shorter fallow periods because of increasing population with less areas to cultivate (ASEAN, 1997). In the Mekong basin, deforestation will probably intensify as infrastructure increases access for logging and population pressure increases demand for land. Commercial logging bans in Cambodia, Thailand, Vietnam and Lao PDR have decreased deforestation in some of these countries but have not succeeded in halting it completely (MoSTE/ OEPP, Thailand, 1998). Since July 1997, Vietnam's Government has gradually reduced the logging from natural forests from 620,000 Cubic Metre in 1996 to 520,000 Cubic Metre in 1997 and has targeted to further reduce it to less than 300,000 Cubic Metre by the year 2000, and to fully ban it by 2003. Along with reducing logging from natural forests, the Vietnamese Government has approved a reforestation plan for 5 million hectares in the period of 1997-2010 (MoSTE, Vietnam, 1998).

In East Asia, the trade-off between forest protection and development will become a critical issue, particularly in Japan, Korea DPR, and Republic of Korea where there are limited flat lands for urban and industrial expansion, and where encroachment of forested mountainous regions is already taking place. Japan's policy to shift timber supply from foreign to domestic resources will further stimulate expansion of deforested areas once labor shortages in the forestry sector have been removed. The Korea Republic's 10-year plan aimed at attaining over 50percent self-sufficiency in the supply of timber by 2030 by maximizing the efficiency and benefit of forest utilization may meet with some success but in the meantime both Korea DPR and Republic of Korea will continue to depend on foreign sources for timber. In China, it is estimated that by 2010, the reforested area will be increased by another 28.98 million hectares, to 17 percent of total land, and to 21 percent by the mid 21st century.

In Australia, the Natural Heritage Trust is funding a Farm Forestry Programme promoting native tree forestry on cleared agricultural land. The Plantation 2020 Vision aims to triple the area of Australia's

plantation estate from one to three million hectares by 2020. As a member of the Montreal Process Working Group, Australia is aiming to improve its forest industry. For example, Regional Forest Agreements (RFAs) have been negotiated between the Commonwealth, State and Territory governments of Australia to provide, over the next 20 years, for a world-class forest reserve system; certainty for industries and regional communities; and ecologically sustainable management of the whole forest estate, both on and off reserves. RFAs are based on comprehensive assessments of forest values and uses and three have been completed to date (http://www.rfa.gov.au/cra/cra-rfa-over.html).

New Zealand's native forests will increase in area as scrub continues to regenerate on abandoned hill pasture. The scale of this regeneration is not yet known. The main risks to this scenario are from: pests, either a reduction in the resources devoted to possum, goat and deer control, or the accidental importation of invertebrate pests, such as the White Spotted Tussock Moth; and commodity price movements, if world markets swing back toward high returns for sheep and goat products then large areas of regenerating hill forest could once again be converted to pasture (though such a swing is considered unlikely). For the exotic forests, it is expected that planting will continue at a rate of 50,000 hectares a year up to 2010, bringing the total area to more than 2 million hectares (New Zealand GEO-2 Input, 1998).

In conclusion, with more than half the world's population, but only 13 percent of the world's forestland, Asia has just one-third as much forest per person as the world average. By and large, Asia's forest is shrinking by 1percent a year (ADB, 1997). Excessive cutting of industrial timber and fuelwood and agricultural expansion are the main direct causes of deforestation. Industrialization and urban expansion are significant driving forces. Forest fires and disease are also contributing significantly to forest destruction in the region.

4.2.3 Biodiversity

With only about 10-30 percent of natural habitats left in many countries of the region, any further decrease could have much more serious consequences for biodiversity than the initial stage, when 50 percent of the original habitat was lost. With projections based on such premises, some scientists predict that a mass extinction of species can take place in the tropics within the next 20-25 years.

In the coming decade, increasing pressure from burgeoning population growth, liberal economic policy and land use change will continue to threaten the region's biodiversity. The rate of degradation may slow down because of some initiatives taken, but weak policies and poor management will continue to cause strain on limited resources. Throughout the region there is an urgent need to integrate policies for the sustainable management and conservation of biodiversity into the overall national planning systems. Transboundary protected area management should also feature high in regional policy considerations. All such measures need to be backed up by sufficient funds, dissemination of information and regional capacity building.

In South Asia, with steadily increasing populations, economic liberalization and pressure to increase agricultural production, the current trends of biodiversity loss show little signs of abating. By 2005, India is expected to produce 75 percent of its rice from just ten varieties compared with the 30,000 varieties traditionally cultivated (Ryan, 1992).

In Southeast Asia, current efforts to protect conserved forest areas appear to be inadequate to cope with high rates of encroachment and wildlife hunting and, with continuing pressure from population growth and land-use change, the risk of biodiversity loss over the next decade is likely to be high (ASEAN, 1997). City expansion in coastal areas is likely to be the main cause of coastal mangrove and biodiversity degradation in the future.

In East Asia, pressure from different developmental activities will continue to threaten biodiversity. The overuse of marine resources will result in the continuing loss of marine biodiversity, and fish in particular will be exploited beyond the replacement level. China and Mongolia will increase efforts to protect the remaining populations of endangered species of flora and fauna.

Loss of biodiversity is recognized as one of Australia's most pressing environmental problems. Overall indications suggest that vegetation clearing and thinning, introduced species, and overfishing will continue exert major pressures on Australia's biodiversity (Commonwealth of Australia, 1996). The introduction of major revegetation programmes, more stringent land clearing regulations in some States and Territories, ecologically sustainable fishery and forestry management, and nationally coordinated management of exotic pests (e.g. national release of Calici virus to kill rabbits) are all aimed at reducing future biodiversity loss in Australia. A change in the public perception of

biodiversity by enterprises and governments, in particular, will greatly assist conservation efforts - both within and off reserves. While Australia is a world leader in the use of satellite imagery and GIS to reveal the extent of vegetation clearing and over-grazing from one period to another, much work remains to be done in "ground-truthing" various satellite data and inventorying and monitoring Australia's species and genetic diversity. The use of new management strategies, particularly ecologically sustainable development and the precautionary principle, will be given greater attention in the coming decades to reverse the effects of many current practices that are not sustainable and have eroded the resources.

In New Zealand, legislation and strategies are now in place to prevent people from putting new pressures on biodiversity. The Department of Conservation has had a recent increase in funding to expand its pest control and endangered species recovery programmes. These measures will prevent the disappearance of New Zealand's most threatened species and ecosystems. However, they will not prevent the widespread decline in populations resulting from past habitat removal. Fragmented lowland forests and degraded wetlands continue to deteriorate because they are too small, too modified or too pest-infested to remain viable. The species within will continue to decline as a result (New Zealand GEO-2 Input, 1998).

Action Plan

The rich biodiversity of the Asia-Pacific region is under serious threat from a variety of causes. The growing loss of habitats is the primary cause of the diminishing number of species and genetic diversity. The rise of modern agriculture with its tendency to raise monocultures has also contributed to a serious loss of genetic diversity. Most of the countries in the region do not have a complete and concrete listing of species and there is little information on most of the ecosystems. In the coming decade, increasing pressure from population growth, liberal economic policies and land use changes will likely threaten the region's biodiversity. The actions proposed to be taken to protect the biodiversity included (MCED 2000):

- Prepare or review National Action Plans for forestry, grasslands, coastal and marine areas, and river and wetland management.
- Identify critical areas and species to be protected, including those threatened by the development process, and prepare an enhanced National Management Plan for the conservation of biodiversity.
- Prepare or update a biodiversity inventory to support strengthened planning and management of protected areas and biodiversity conservation. Establish gene banks, for example, in situ gene banks and village ex situ collection, where they have not yet been established. Promote a regional inventory of critical ecosystem, habitat, and species for biodiversity conservation.
- Promote the implementation of the Convention on Biological Diversity (CBD) and the early ratification of the biosafety protocol. Encourage increased adherence to CITES.
- Assess the status of information on biodiversity conservation, including forests, wetland and lakes, and the establishment of comprehensive database at national, subregional and regional levels.
- Develop national mechanism for the protection of traditional knowledge and related rights, including intellectual property right. Document traditional knowledge and practices in biodiversity conservation.
- Ensure stakeholders participation including participation of women, community based organizations, user groups and the private sectors in biodiversity conservation. Empower local people and local government to protect biodiversity at the local level. Promote enhanced community forest management at the national level to cover specific degraded forests.
- Promote capacity building in human resource development in assessment, conservation and research in biodiversity and forestry management.
- Promote subregional and regional cooperation on training, information sharing, and networking of protection and management of biodiversity.

4.2.4 Water

With current levels of population growth, demand for water will increase in each sector throughout the region up to and beyond the next century, intensifying the problems of scarcity. By 2017, India is expected to be water stressed with per capita water decreased to around 1,600 Cubic Metre. Total demand for water is projected to nearly double by 2025. Iran is also approaching water scarcity and China may come close to the water stress threshold by 2025 (WRI/UNEP/UNDP, 1992). Agriculture will continue to claim the bulk of water supplies as larger irrigation systems are introduced in an effort to increase production to meet the projected two-fold demand for grains to feed the region's population. However, water availability is likely

to be the limiting factor for food security in populous and relatively arid areas throughout the region where falling water tables have negative implications for both the sustainability and expansion of irrigated agriculture.

Throughout the region, freshwater demand is growing fastest in the urban and industrial sectors. In most countries, urban populations will probably triple in the next four decades and domestic demand for water may expand five-fold due to the improvement of living standards. Increased industrialization will further intensify demand and exacerbate the problems of scarcity and deteriorating quality, especially in countries prone to droughts and desertification. As a consequence, a major freshwater issue in many countries of the region will be how to allocate scarce water resources among the various competing sectors. In many countries, water is subsidized and its allocation depends primarily on the country's general development strategy and traditional patterns of water use. A major challenge may include changing water-pricing policies (e.g. eliminating water subsidies) and introducing more stringent regulations and efficient pollution management policies.

In South Asian countries such as Bangladesh, there is little scope left for expanding cropland, and the required increase in production must come from intensive, higher yielding, irrigated agriculture (ESCAP, 1995). Without better management practices, groundwater depletion is likely to be aggravated. At present rates of exploitation, the aquifer in Male, for instance, is expected to be exhausted in the next few years (Government of Maldives, 1994). In India, the total demand for water is projected to nearly double by 2025. Water demand is growing fastest in the urban and industrial sectors and is projected to climb 135 percent over the next 40 years. The situation will become worse in arid areas, such as Rajasthan, where 8 percent of the population use only 1 percent of the country's total water resources.

Over the next decade the Southeast Asian region will also experience continuing degradation of surface and groundwater quality although it still has adequate supply to cope with the increasing demand. Indonesia and Malaysia currently withdraw a relatively small proportion of available freshwater. However, the Philippines and Thailand are slowly approaching the water scarcity threshold (ASEAN 1997). Singapore is currently managing its water resources well with a portion of its freshwater supply coming from Malaysia (MoE, Singapore, 1998). Rapid industrial and urban development in this sub-region will accelerate water demand. In contrast, water demand for agriculture will increase more slowly as potential for large-scale water development projects is reaching its limit. Increasing freshwater demand among different sectors will cause serious water-use conflicts. With localized exceptions, water quality throughout the Mekong River basin is generally good. However, human activities and associated pollution are increasing and are expected to have a significant adverse impact in the coming years.

In East Asia, population growth, affluence and industrial development will increase water demand especially for domestic and industrial use. In Mongolia, groundwater availability will be a main concern owing to the scarcity of surface water supplies. The Republic of Korea has initiated a set of ambitious water quality targets for 2001 and 2005, but with serious eutrophication, particularly in lakes, it will be difficult to meet these standards, especially in view of increasing fertilizer use. In China, water pollution will worsen throughout the country, except for some inland rivers and large reservoirs.

In Australia, one of the important trends foreseen is the growth of irrigated agriculture, particularly in the Murray-Darling Basin. However, irrigation in the Murray-Darling Basin is nearly at the limit of the water resource, indicating that future expansion of irrigated agriculture will be largely through productivity increases and industry restructuring (Australia SoE, 1996). The future quality and availability of freshwater in Australia is one of the most pressing environmental problems in that country. It is expected that nutrient and sediment levels in streams and pesticide levels in both surface water and groundwater will increase. While a limit has been placed on the future expansion of water diversion activities in the Murray-Darling Basin, several other irrigation areas, most notably the Burdekin river delta in north Queensland and the Ord river irrigation scheme in northern Australia, are expected to expand rapidly in the future (Commonwealth of Australia, 1996).

New Zealand is likely to experience the following trends over the next decade in the absence of new policy measures: a small reduction in sedimentation and flood water flows as forest returns to retired hill pastures; further improvements in direct discharges from farms, factories and sewage treatment facilities; further improvements in the quality of drinking water supplies; increasing nutrient concentrations in dairying catchments; further deterioration in shallow streams, lakes and groundwater in dairying areas; further changes to lakes and rivers for small-scale hydro development; and further conversions of wetland to dairy pasture. Water shortages are also likely to be a recurrent summer problem along the east coast and in several major cities,

including Auckland and Christchurch (New Zealand GEO-2 Input, 1998).

Action Plan

Growing populations and water contamination from a wide range of domestic, industrial, urban and agricultural sources imply reduced per capita water availability. The challenge will be to use dwindling supplies of freshwater to satisfy a wide range of demands, and to increase national, sub-regional and regional cooperation to avoid possible conflicts in the use of shared water resources. The measures need to be taken to increase water resources in the region included:

- Formulate or review national water policy to address issues related to water uses, water security, and management of water ecosystem. Policy should address drinking water supply, and use of water for irrigation, industry, hydropower and other sectors. Policy also addresses issues such as planning of water resource development projects, maximizing water availability, water pricing, water quality, water zoning for proper management of resources.
- Establish or strengthen regulatory framework for protection and management of water resources and develop institutional mechanism to enforce legal provisions.
- Formulate programme for integrated water resource management and promotion of their implementation through strategic planning and management, effective demand management, better public participation, and improved institutional, legal and policy frameworks.
- Increase availability of freshwater through introduction of cleaner technology in agriculture, industrial and other water consuming sectors. Water availability will also increase with water shed management, river and lake water cleaning programmes, and rain water-harvesting techniques.
- Introduce market based pricing for demand management and efficient uses of water.
- Establish a realistic water budget through proper inventory of demand, supply, and availability of surface and ground water.
- Capacity building of human resources in the area of water resource development and management, including water quality monitoring, water reuse and recycling, assessment techniques, database management, and sewage treatments.

4.2.5 Marine and Coastal

Coastal pollution as well as loss of marine resources will increase over the next decade (ESCAP, 1995). In 2000, nearly half of the world's coastal population in urban conglomerations are living along the shores of Asia. Untreated urban and industrial waste that finds its way into the sea from these rapidly growing cities will continue to constitute a major threat to the marine environment and biodiversity. Aquaculture production will be increasingly important to the region since many marine fish stocks have reached their maximum exploitative level.

In Southeast Asia, the coastal urban population is nearly doubled by the year 2000. With the exception of Cambodia, where the cutting of mangroves for charcoal production and the conversion of forest to shrimp farms are growing concerns (MRC/UNEP, 1997a), the rate of mangrove forest depletion and coastal environmental degradation may slow down due to the introduction and implementation of protective measures and mangrove regeneration (ASEAN, 1997).

In East Asia, conflicts between protection and development along coastal areas will become more critical because of growing industrialization and the lack of suitable flat land for development. In Korea DPR and Republic of Korea, high population growth and the development of economic activities may increase domestic and industrial wastes that will probably exceed the countries' waste treatment and disposal capacities (JEC, 1997). In China, the overall quality of coastal waters will continue to decline in the coming decade.

With current trends in New Zealand, it is likely that sea temperatures and levels will continue to rise slightly in the coming decade; nutrient concentrations will increase; sedimentation rates may decline slightly as steepland pasture erosion declines; heavy metal pollution from motor vehicles and urban storm water will increase; and plastic and paper litter from urban storm water will also increase (New Zealand GEO-2 Input, 1998).

Action Plan

The consequences of marine and coastal environmental pollution in the Asia-Pacific region are becoming increasingly evident although the level of pollution in most coastal waters is still manageable and the overall quality of the marine environment remains good. However, population growth and accelerated economic, urban and industrial development in coastal

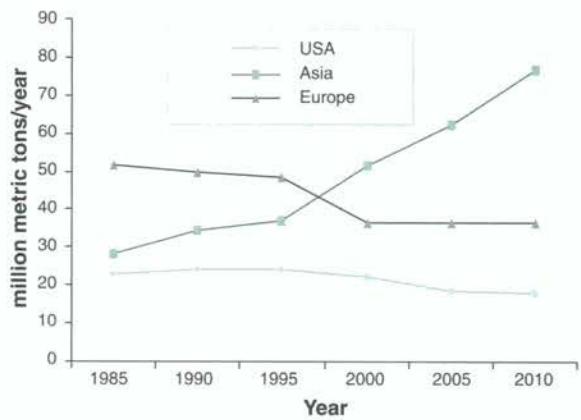
areas have increased pressure on coastal and marine resources and resulted in increased domestic and industrial effluents, more areas of landfill, increased dredging, more mangrove areas cleared, more discharge of agrochemicals, and increased coastal and estuarine sedimentation and erosion of coastlines. It has become clear that the uncontrolled exploitation of the region's coastal resources requires a more effective institutional management system and that there is a critical and urgent need to move from information gathering to concrete actions aimed at management and problem-solving. The measures proposed for priority action are the following (MCED 2000):

- Promote sustainable management and use of coastal and marine resources through an integrated coastal zone management plan.
- Identify fragile and sensitive coastal and marine environment and develop action plans for their conservations.
- Develop database and mapping on the state of the coastal and marine environment and resources, including small island and tourist destination. Use of GIS and remote sensing techniques for mapping and developing management plan for coastal zones.
- Establish monitoring system to assess the health of the marine system, pressure on coral reefs, and water quality parameters.
- Formulate or review environmental legislations and regulations to control pollution from land based sources. Provisions for economic incentives to control pollution from land base sources.
- Implement regional action plan for land based sources of pollution under the global programme of action for the protection of the marine environment from land-based activities.
- Integrate environmental and social issues with economic planning and use of economic instruments in protecting coastal and marine environment. Prepare a master plan for environmentally sound coastal tourism.
- Promote partnership among stakeholders for planning, development and management of the resources of the coastal areas.
- Strengthen capacity building in various aspects of coastal zone management and ecotourism management, including early warning system of natural disaster and impacts of global climate change.

4.2.6 Air Pollution and climate change

Demand for primary energy in Asia is expected to double every 12 years while the world average is every 28 years. Coal will remain the fuel of choice in the future because of its abundance and easy recoverability, especially in India, China, and Mongolia, and demand is projected to increase by 6.5percent a year (World Bank, 1997c). Figure 4.2 shows the current and

Figure 4.2: Current and Projected SO2 Emissions



Source: World Bank & ADB Data cited in ESCAP, 1995

projected SO_2 emissions.At the current energy consumption growth rate, by the year 2000, SO_2 emissions from coal burning in Asia will surpass the emissions of North America and Europe combined (World Bank, 1997b) and, if current trends in economic development continue, will more than triple within the next 12 years.

This will result in a significant increase in both national and transboundary acid deposition problems. In addition, increasing emissions from transport will aggravate urban air pollution. Many ecosystems may be unable to absorb these increasing acid depositions and levels of pollution and the result may be irreversible ecosystem damage with far-reaching implications for forestry, agriculture, fisheries and tourism.

In over-crowded cities of South Asia, air pollution problems are likely to grow from coal consumption and urbanization. A study of Nepal, for instance, estimates that the total emissions will increase five-fold by 2013, about two-thirds of which are likely to come from the transport sector (Shrestha et al., 1996). Sri Lanka's shift from hydro-based to geothermal-based energy production is expected to result in increased air pollution from geothermal sources (Personal communication, L. Gunaratne) and health risks from

indoor pollution may also intensify over the next six-ten years (Personal communication, S. Saxena). Since the sub-region's problems with regard to air quality are associated with a high dependence on fuelwood largely because of poverty, and a high growth in personalized transport, concerted efforts to address both energy needs and mass transport system development are required.

In Southeast Asia, emissions of greenhouse gases are likely to increase in parallel with rapid economic growth. Although the sub-region's contribution to global greenhouse gas emissions is still small, improvement of energy efficiency, and implementation of initiatives in protecting the global environment under ASEAN will help to reduce the growing emission trends (ASEAN, 1997). ASEAN has also stepped up efforts to reduce the forest fires and its effects through collective and cooperative actions.

In East Asia, transboundary air pollution, thought to be caused mainly by sulfur emissions from coal burning and power plants in Korea DPR and China, may worsen. The Korean peninsula will more seriously suffer from cross-border acid rain. Mongolia may receive acid rain originating over its northwestern border with Russia. In China, the current heavy reliance on coal is expected to continue as the structure of energy production and consumption will not change significantly over the next decade, thus, the air pollution problems may remain unabated. And in Japan, the total amounts of NO_2 and CO_2 emissions and photochemical pollution will continue to be a problem.

Urban air pollution trends in Australia are likely to improve for lead and sulfur dioxide. Ozone trends are difficult to assess because increases in new vehicles (with catalytic converter systems) may be offset by increases in the number of vehicles and urban sprawl. Further research is needed on emissions of air toxics and particulates, and diesel emission standards need updating. Several barriers exist to effective air pollution management. NH&MRC guidelines for the protection of human health are agreed for a range of individual pollutants but the guidelines are not uniformly applied across jurisdictions. Away from major population centers, air quality is regarded as generally good, although it should be noted that air quality is not quantitatively monitored over 95 percent of the continent. Limited studies show that Australians spend 90 percent of their time indoors, where the range of pollutants is often greater than outdoors. However, no systematic monitoring of indoor air quality is undertaken in Australia (Commonwealth of Australia, 1996).

Australia's relatively high carbon dioxide emissions have become much higher in the last two decades. Relatively high dependence on fossil fuels (compared with other OECD countries), the lack of nuclear power and the limited opportunities for hydro-electricity generation will all continue to restrict the available options to reduce CO2 if there are no alternative options in place for the use of renewable energy sources and natural gas in place of fossil fuels (coal, oil, and gas) (Australia SoE, 1996). Because of its strong natural resource base, competitive prices and a ready supply of fossil fuels, Australia has a competitive advantage in energy-intensive industries such as minerals processing, iron and steel, non-ferrous metals, chemicals, pulp and paper (Commonwealth of Australia, 1997b). But under the Kyoto framework, Australia will be required to limit its growth in greenhouse gas emissions during the period 2008-2012 to 8percent above 1990 levels (Commonwealth of Australia, 1998b).

New Zealand's Ministry of Commerce is expecting energy demand to rise at about 1.5percent per year, or 15percent over the coming decade. There is no sign that the growth in vehicle numbers is slowing, though the projected rise in world oil prices around 2005 may have a dampening effect on motor vehicle use. There is also no sign of the growth in New Zealand's dairy herd slowing, though physical and environmental limits must eventually be reached. Based on current trends, gross CO_2 emissions for the coming decade will be 25 percent greater than the 1990 level. Net emissions for the period will be only 40percent of gross emissions, but this level is three times more than 1990 level (the official policy target until 1998). Depending on livestock trends, methane emissions may also exceed 1990 level at some point in the next decade. Based on climate trends of recent decades it is predicted that average temperatures in New Zealand will continue to rise in the coming decade and that ultraviolet radiation will continue to intensify. Scientists are uncertain about the potential interaction of climate warming with El Ni?o. This recurrent climatic pattern, which periodically makes New Zealand cooler, drier, and more prone to cyclones, has been particularly prominent in the past decade. Some scientists suspect that it may increase in frequency or duration as the climate warms (New Zealand GEO-2 Input, 1998).

Action Plan

As the energy plans of many countries, particularly China, India, Mongolia and Thailand, require large increases in coal combustion, acid deposition is likely to become a serious problem in the near future. While

the region's contribution to the greenhouse effect is limited, any global warming and sea level rise resulting from the phenomenon are expected to have significant impacts on some countries. The measures proposed on mitigation and control of air pollution and green house gas (GHG) emissions are the following:

- Framing or review appropriate policy, legislations, and strategies to integrate air pollution and climate change issues into national development plan and sectoral plan, including energy, industry, agriculture, and transport.
- Ensure implementation of these policies and legislations on control of air pollution and GHG emission through promoting monitoring mechanism, assessment and reporting, developing indicators and public participation.
- Develop action plan on mitigation and control of air pollution and GHG emissions in urban cities through introducing public/mass rapid transport system, reducing traffic congestion, proper land use planning, and switching over to cleaner fuels like CNG.
- Update national inventories of GHG sources and sinks in accordance with the guidelines formulated by the International Panel on Climate Change. Identify least-cost abatement options and formulate national strategies for the abatement of future GHG emission.
- Develop institutional, technical and human capabilities at the national level to monitoring, reporting and control of air pollution and GHG emissions.
- Strengthening the system of monitoring of transboundary air pollution and acid rain at the subregional and regional level.
- Promote public awareness of air pollution and climate change issues and encourage the participation of all stakeholders in activities addressing air pollution and climate change issues.
- Promote subregional and regional cooperation on information dissemination, monitoring of transboundary air pollution, capacity building, technology transfer, developing subregional and regional position on issues of air pollution and climate change.

4.3 SCENARIO ON SOCIO-ECONOMIC DEVELOPMENTS

A "business as usual" scenario suggests that rapid economic growth and industrialization may result in further environmental degradation and it is entirely possible that the Asia-Pacific region may become more degraded, less forested, more polluted and less ecologically diverse in the future. Asia's particular style of urbanization, toward mega-cities rather than mid-sized cities, is likely to further exacerbate environmental and social stresses (ADB, 1997).

The most important external force shaping Asia's future will be the increased integration of the world economy. Global trade provides access to the information, ideas, technologies, and the other critical resources that are the backbone of economic progress. Greater mobility of international capital will also mean less scope for autonomy in macroeconomic policy. In the future, as recent events in Southeast and East Asia have shown, global capital markets will react to the changes in fiscal and monetary policies more quickly and more severely than in the past.

However, despite the recent slowdown in many economies, the general outlook points towards higher rates of economic growth and an increased inflow in foreign direct investment in the region. This may boost GDP but may not be enough in itself to alleviate the problems of some disadvantaged groups, particularly the rural and urban poor, for whom income distribution remains a pressing issue. Nevertheless, if the region's potential is properly utilized, the future could still be brighter than the past.

It is in South Asia where the promise of growth and improvement in the quality of life over the next 30 years is greatest (ADB, 1997). A more favorable demographic profile, improving economic policies and better governance structures, offer South Asia enormous potential. In the next 30 years, South Asia has the opportunity to elevate its growth to the rates observed in the past 30 years in East and Southeast Asia. By 2025, income per person in South Asia could increase by four times (ADB 1997). In the Mekong basin, if Cambodia, Lao PDR, Myanmar and Vietnam can continue to experience slowing population growth and economic growth rates of 7-10 percent as they have in the last three years, per capita income could be expected to be more than double within a decade and could even result in a three- to four- fold increase in the next 25 years (ADB, 1997). Even though most Southeast Asian countries have attained an average of 10 percent or higher for the past three decades, the forecast for economic growth over the next decade seems to be uncertain. The fast growing countries of East Asia still have the opportunity to continue to grow rapidly, though at rates that are likely to be somewhat slower than in the past, precisely because they have been so successful at catching up to date (ADB, 1997).

Environmental progress in Australia will depend on: development of appropriate environmental policies, legislation and strategies of local, State/Territory and Commonwealth Governments; the integration of environmental concerns in sectoral and industrial policies; and the action taken by community groups, including enterprises and households. Climate variability, principally due to El Nino Southern Oscillation events, has been a constant problem for Australians because it causes natural fluctuations in vegetation and fauna. However, it is not this variability, or other features such as the poor soils or average low rainfall, that puts the actual pressure on its environment. Rather, it is the implementation of management activities or policies that fail to take sufficient account of these inherent features. Australia will likely continue to rely on natural resource intensive industries as part of its domestic and export trade activities. Hence, an integrated systems-based approach to management of natural resources is a future priority for Australia (Commonwealth of Australia, 1996; OECD, 1998).

Projections of economic growth in New Zealand for 2010 are very uncertain. Official government predictions envisage 3-4 percent annual growth, but such predictions have generally failed in the past and more detached commentators do not expect sustained growth rates above 2 percent. Predictions of social conditions in terms of income level and availability of full-time jobs and welfare benefits for 2010 depend to some extent on economic progress over the next decade, and to some extent on government policies for dealing with society's disadvantaged. If current policy trends continue, the gap between rich and poor will continue to widen. With regard to the population trend, assuming "medium" fertility (i.e. a continuation of the present 2 children per woman) and average net immigration of some 5,000 per year, New Zealand's population in 2011 will reach about 4.1 million, rising to 4.6 million by 2031-with a larger adult and elderly population but a fairly constant under-15 population (Statistics New Zealand, 1997). This represents a density increase from about 13 people per square kilometer to 15 in 2011. Nationally, this is not expected to create undue environmental stress, but in the Auckland Region it may put extra strains on water supplies and waste disposal services that are already under heavy pressure (New Zealand GEO-2 Input, 1998).

Urbanization

In most countries of the region, the urban population is likely to grow three-fold in the next 40 years and by 2025, there will be approximately the same number of city dwellers as the total population of the whole region in 1990 (ESCAP, 1995). This represents a predicted population of 2.5 billion persons, out of the total of 4.3 billion expected in the whole region. Increases in traffic congestion, water and air pollution, and growth of slums and squatters settlements are just a few of the negative impacts that can be expected (ESCAP, 1995). Most large Asian cities already face an acute shortage of safe drinking water and a five-fold increase in demand is anticipated within the next 40 years (ESCAP, 1995). In addition, rapid industrialization means a parallel growth in demand for industrial water. The cost of new water supply systems is expected to double or triple in coming years and improved sewage systems will be needed to cope with the increase in wastewater. Already public expenditure on water and sanitation is around one percent of GDP for most countries of the region, and is likely to rise.

In South Asia, by 2015, there will be 7 new mega-cities and, by 2025, the sub-region is expected to have the highest ratio of population in mega-cities. In 2000, Bombay, Calcutta, Delhi, Madras (Chennai) in India had a population of 18.12 million, 12.66 million, 11.67 million respectively. Lahore and Karachi in Pakistan had 6.2 million and 12.07 million respectively, while Dhaka had a population of 10.19 million. Future challenges include finding solutions to the problems arising from the lack of adequate public/mass transport services and health services, the increasing use of personal vehicles (Singh and Sachdeva, 1996) and other problems associated with road transport - narrow roads, slow moving traffic, congestion, noise pollution, etc. (Murthy and Anjaneyule, 1996). It is expected that a large share of the world's urban poor will continue to live in South Asia (UNEP, 1997).

In Southeast Asia, the urban population is projected to reach 43 percent of the population by the year 2010 when populations in Jakarta, Manila and Bangkok will reach 13.7, 11.8 and 10.3 million, respectively (ASEAN, 1997). These cities will be among the largest megacities of the world. Pollution loading from urban centers and industrial areas will increase in parallel with the urban growth. In some of the Mekong basin countries, pollution loading will increase by 87 percent (MRC, 1997b), of which a significant proportion will be hazardous wastes for which there are currently no facilities for treatment. More aggressive urban environmental management will be needed to cope with these growing pollution problems. The urban environment will continue to be high on the environmental agenda of the sub-region.

In East Asia, many governments are attempting to reduce the growth of their primary cities, by curbing

rural-urban migration. By 2025, the urban population in China is estimated to be 832 million, and in Japan, it is expected to exceed 80 percent of the total population, resulting in a loss of approximately 640,000 hectares of agricultural land area (on average) every year. By 2025, the urban population in Korea DPR and Republic of Korea are expected to be 75.2 percent and 93.7 percent of the total population respectively (UN, 1995). In Mongolia, rural-urban migration has slowed down in recent years and is expected to continue to decline (ESCAP, 1994). In most countries in the sub-region, vehicle numbers are expected to continue to increase, for example, in China where, by 2000, there may be 4.7 motor vehicles per thousand persons and the number of private automobiles and motorcycles will reach 20 million and 45 million, respectively. A new trend of future development for Chinese cities is represented by Dalian, Zhuhai and Xiamen, Zhangjiagang, Shenzhen and Weihai, the Environmental Star Cities, where great efforts are being made to emphasize urban environmental planning and pollution prevention amid economic development (SEPA China, 1998).

With the increasing internationalization of the Australian economy, the county is likely to experience over the coming decades the spread of urbanization along the coastline and population growth in its seven major capital cities, Sydney, Melbourne, Brisbane, Perth, Adelaide, Canberra and Hobart, the main administrative, commercial, industrial and welfare service centers (Australia SoE, 1996). There is some evidence to suggest, at least in Australia, that as settlement sizes increase, resource-use efficiency (per capita) also increases. This trend may be due to greater economies of scale occurring for recycling facilities and recycled-product markets, better public transport, greater access to globally innovative technologies, and more efficient land use (Common wealth of Australia, 1996). However, continuation of this trend for any given settlement clearly depends on several other factors, including the capacity levels of the surrounding environment and the economic circumstances of its residents. Urban sprawl and the large distances between major population centers have been, and are likely to continue to be, major factors behind high levels of vehicle use in Australia (Commonwealth of Australia, 1996). Other important factors likely to affect car use in the future include levels of public transport infrastructure and supplies of crude oil worldwide.

In the absence of new policy measures, the following trends are likely to occur in New Zealand over the next decade: population growth and urban sprawl will continue in the upper North Island and in the fringes and adjacent small towns of most major cities; social and environmental pressures associated with this will intensify in some urban areas; maintaining plentiful water supplies and developing effective water conservation measures will be a prime concern in some urban areas; increasing solid waste disposal will generate increasing pressures on landfills in some areas; stormwater pollution of estuaries and air pollution in heavy traffic corridors are likely to increase; and traffic congestion will create increasing pressure for better public transport services (New Zealand GEO-2 Input, 1998).

In conclusion, urbanization is one of the most significant development issues facing Asia today, affecting all areas of economic, social and environmental planning. Urban growth, access to services, waste and transportation are some key areas of concern. While the ratio of persons living in urban areas (to total population) in Asia still remains lower than that of developed countries, it is rising rapidly. One distinct trend in Asia's urbanization pattern is that of urban primacy with most of the urban population concentrated in a few urban centers.

4.5 IMPROVED GOVERNANCE AND POLICY INITIATIVES

4.5.1 Changing role of the state

It is important to identify and understand the contextual characteristics of each nation before devising legislations to protect the environment. These characteristics include: the natural resource base and trends in the environment; the socio-economic indicators including education and access to basic needs; the economy - its base, growth and type, financial dependence on external resources, including aid and debt, and degree of integration with global economy; the human capacities; the cultural, religious and ethnic diversity and structures, conflict or polarization and internal means of resolving conflict; and the indigenous values, networks and knowledge (UNDP, 1997: 25). A detailed investigation of these characteristics allows key people in government, civil society and the private sector to assess national needs and identify areas for support, as well as, respond rapidly to emerging opportunities. Furthermore, synergies and linkages can be sought between environment, sustainable livelihoods, governance, poverty and gender.

Legislations related to the protection of the environment are by no means complete and their

implementation seems to lag behind the rate of environmental degradation. From the aforementioned case studies, it is evident that the public sector alone cannot adequately manage the environment. One of the most significant challenges at present is to focus on the process of creating viable and sustainable political and institutional systems within which strategies, programmes and policies for environmental management can be framed and implemented. The systems should incorporate: the cultural characteristics of the nation and region; incentives and innovative means of gaining and securing financial resources; decentralization of responsibilities to the local and provincial levels; a supporting and stimulating environment for public-private partnership and stakeholder participation to take place; mechanisms for transparency and accountability; and the encouragement and provision of capacity building services to articulate goals and manage change.

Conceptually, the role of government should switch from that of prime player, implementing its own policies, to that of coordinator, facilitator and enabler of environmental strategies and policies. Central to this role is a shift towards strategies, which bring together actors and agencies at local, national and international levels, across public, private and voluntary sectors. It can be argued that each city or community has its own unique range of problems and priorities, thus, the process of participation and cooperation is a good mechanism to decide on the best possible use of limited resources.

One of the government's responsibilities is to establish and maintain stable, effective and equitable legal-regulatory frameworks for public and private activities by creating an enabling environment for sustainable development (UNDP, 1997). With respect to the private sector, the government has a role in promoting private sector investment by providing an enabling climate for investment in environmentally-sensitive development. At the same time, the government should regulate private sector activities by setting harsh sanctions for violating the rule of law. The private sector should also be given the responsibility to play a part in protecting the environment (Reyes, 1998). Environmental organizations responsible for enforcing environmental laws need to set realistic environmental standards by designing a time frame within which pollution control measures have to be carried out since unrealistic standards can result in non-compliance. However, failure to meet the objectives should result in strict sanctions in terms of fines and imprisonment.

State institutions can also empower the people they are meant to serve by providing equal opportunities, ensuring social, economic and political inclusion, and providing access to resources. The legal enactment of decentralization is essential because a decentralized government can enable people to participate more directly in environmental management processes and can help empower people previously excluded from the decision-making process. Suggestions include the emphasis of the legal system on multipartite cooperation to establish clear standards and a comprehensive monitoring system. A local and decentralized monitoring system can be set up to regulate industries' emission of undesirable by-products. The establishment of a university-industry linkage may also be beneficial in some cases. The involvement of people in all stages of the project can improve cost-effectiveness, sustainability and environmental knowledge.

However, people can be empowered only if their legislatures, electoral processes and legal and judicial systems operate effectively to protect the rule of law and the rights of all. The government sector should also decentralize political and economic systems to be more responsive to citizens' demands and changing economic conditions. Roles and responsibilities should also be clearly indicated at the policy level to avoid conflicts and the overlapping of responsibilities, as well as, to improve coordination and cooperation (UNDP, 1997). All in all, the state should play a facilitating and regulatory role to provide an enabling climate for the private sector and civil society organizations to participate in resources provision and decision-making processes with respect to environmental protection, and at the same time ensure that the rule of law is adhered to. Due to the contextual differences in each country, it is important to develop policies, tools, instruments, methodologies and procedures based on country experiences. These experiences ought to be shared regionally and internationally as a means of fostering regional and international cooperation.

Finally, the government should include in the country's legislation and practice the commitment to:

- Spread information about its plans, programmes, policies and laws since information is power and nothing can empower local government and communities more than a knowledge of the resources available to them, how they can use these resources and what their rights are;
- Support education and ecological awareness in order to help people become aware of the importance of their environment for their survival;

- Become a trainer and provider of technical assistance; and
- Develop a research capacity in ecologically and socially appropriate technical systems. This should include, not only modern science and technology, but also the traditional knowledge systems of the people, which help all concerned to understand how the people have optimized their use of local resources over the centuries.

4.5.2 Regional and international cooperation

The developing countries of the Asia-Pacific region suffer from a myriad of complex environmental problems, which are incapable of resolution by the actions of individual nations alone. Most countries lack the resources to implement even the most rudimentary of environmental management regimes. Further, as many of the environmental issues transcend national boundaries, it would be nonsensical for any state to unilaterally attempt to protect its environment. Therefore, it is through regional and international relations that environmental protection can be assured. Environmental law in general should facilitate sharing of regional experiences, establish regional centers and networks, encourage flexible and region-wide support to develop national environmental programmes, promote regional briefings and training, and urge the carrying out of regional studies and trends (UNDP, 1997).

The exchange of information, scientific research and technical assistance that help lawmakers and policymakers are and will continue to be a critical aspect of environmental protection in the future. Virtually every international environmental treaty has general provisions requiring cooperation in generating and exchanging relevant information. Examples include the Vienna Convention for the Protection of the Ozone Layer, which facilitates the exchange of scientific, technical, socio-economic and commercial data, as well as legal information; the 1982 U.N. Convention on the Law of the Sea, which describes the exchange of data related to pollution of the marine environment; and the Biodiversity Convention, which requires information exchange on the conservation and sustainable use of biological diversity. When one state wants to act in the territory of another state, simple notification and consultation has not been deemed sufficient and most treaties now require the acting state to obtain the other state's prior informed consent. Thus, for example, a party to the Basel Convention that seeks to export hazardous wastes must inform the importing state of the nature of the wastes and receive the written consent of the importing state (Hunter, et. al., 1994).

4.5.3 Economic instruments and public-private partnership

Legislations should contain legally instituted economic incentives and disincentives e.g. polluters pay principle, tax holidays and austere sanctions, etc. Limits of the legal instruments in protecting the environment have inspired the drafter of Agenda 21 to state that "environmental law and regulation are important but cannot alone be expected to deal with the problems of environment and development. Prices, markets and governmental fiscal and economic policies also play a complementary role in shaping attitudes and behavior towards the environment" (in Mushkat, 1993: 184). The polluters pay principle promotes the notion that those who burden or harm the environment are required to bear the costs of avoiding, eliminating or compensating for environmental injuries. As business is forced to internalize its environmental costs within a well balanced framework of regulatory controls and economic instruments, the incentive to prevent pollution and minimise waste will grow (Phantumvanit & Hunt, undated).

Drawing from the experiences of industrialized countries, the recent environmental policy development in the Asia-Pacific region has been the shift towards the use of economic instruments to complement the command and control approach. In Malaysia, a discharge fee has been imposed since 1978 to complement the regulatory approach in solving water pollution from palm oil mills. With the standards becoming more stringent and the discharge fee growing higher over time, the BOD load released in public water bodies dropped steadily from 222 tonnes per day in 1978 to 58 tonnes in 1980 and 5 tonnes in 1984. In Singapore, road pricing was introduced as early as the 1970s to reduce road congestion and control air pollution. Area licensing scheme was adopted by charging drivers for using roads in the city center during peak hours. The scheme reduced the traffic by as much as 70 percent during peak hours (O'Conner, 1996). In Thailand, a combination of economic incentives and command and control is being used to solving air pollution in Bangkok. Price differentials have been set between non-leaded and leaded gasoline. The non-leaded gasoline is subsidized while the leaded gasoline is taxed. Meanwhile, all new cars are required to install catalytic converters to reduce air pollution (Panayotou, 1994).

Economic instruments have also been indirectly introduced through privatization of various public utility and infrastructural systems. In Thailand, for example, a Wastewater Management Organisation has been

established to manage domestic wastewater treatment system by charging the public for the services. Similarly, this economic approach has also been used in some Asia-Pacific countries to increase private sector participation in other public utilities, such as, power supply in Thailand and the Philippines. In these countries, small and independent power producers programmes are initiated to encourage the private sector to sell their excess power to the public (MOSTE, 1997).

Despite the number of economic instruments adopted in Asia-Pacific countries, the application, so far, has been limited to certain sectors (e.g. mainly in the wastewater treatment and the transportation systems) and under specific conditions (e.g. Singapore's road pricing strategy is successful mainly because of its small size, the existence of a reliable and accessible public transport system, effective and efficient land-use planning system, and the people's culture, among others). Commercial and industrial enterprises operating in the Asia-Pacific region still need to be made aware that the adoption of a more environmentally sound business results in long-term cost savings particularly in the cost of clean-up. In this regard, policies that encourage productive investment in new, cleaner production methods that produce less pollution of any kind, is essential. Environmental legislation should encourage the use of innovative and new environmentally-friendly technologies that also serve unique local circumstances.

To meet the challenge of managing a continuously deteriorating environment, economic instruments and partnership programmes need to be institutionalized into broader environmental management policies in the Asia-Pacific countries. This can be achieved through their enactment in legislation. In addition, capacity building (both individual and organizational) to develop environmental awareness and know-how among all levels and sectors and administrative procedures for implementing these economic instruments (e.g. the collection of user charges) are essential for effective implementation of environmental law. Fines and fees collected through these schemes could be placed in an environment fund. In Thailand, for example, the 1992 Environment Act established the Environment Fund to provide grants and loans to government, private sector and non-governmental organisations, in support of environmental protection (TEI, 1997).

When responsibilities are delegated to other groups and levels this should be matched by a devolution of power, skilled personnel and financial resources. This devolution of power should be reinforced in environmental law. Currently, most local governments lack the capacity and the authority to raise revenues through taxation and license fees, and in the majority of developing countries, they are not incorporated as legal entities permitted to borrow money in the private commercial sector or to enter into legal partnership agreements with private or community sector organizations. Without being legal entities, they are unable to own land, even if central government were disposed to grant them power of compulsory purchase. In many countries, local governments outside the largest cities are not empowered to control physical development.

4.5.4 *Stakeholders' participation*

An increased role for non-governmental organizations and the private sector is being considered and is already evident in some parts of the Asia-Pacific region. It is now becoming accepted that the public sector alone cannot meet the needs and aspirations of the entire population. Due to the possibilities offered by the non-governmental organizations and the private sector, governments should formulate legislations that encourage and stimulate other actors to undertake management functions in coordination and cooperation with the government's own limited activities. Government collaboration with civil society organizations is important because of their innovation, direct relationship with the poor, capacity to stimulate participation and articulate local views (UNDP, 1997). Furthermore, public involvement can also contribute to cost-sharing and greater project efficiency in the long run (Moser, 1989). The legal and regulatory system should allow an environment in which civil society organizations are empowered to participate in developmental issues, and stakeholders are encouraged to partner with each other.

There should be an explicit duty pertaining to public participation in all aspects of environmental decision-making and effective enforcement mechanisms. In the prevailing scenario - of alarming environmental degradation; inefficiency and unwillingness of the environmental agencies to protect the environment; few prosecutions and minimal convictions under the anti-pollution laws; lack of environmental awareness; and ubiquitous corruption - the public interest would be better served if civil society, including non-governmental organizations and individuals, are armed not only with the right to prosecute a polluter but also with the right to information. For public participation to be effective, there must be free and open access to information about the state of the environment and about the operations of various organizations and activities that are affecting the environment.

The initiation of changes in ownership rights for land and natural resources in cases where they belong to the state is also crucial because it is a psychological reality that people will not make long-term investments on land for soil and water conservation measures unless they have secure land tenure (Oposa, 1996). Moreover, in most cases, common law would not assist someone with no property interest who is affected by exposure to pollution, or in cases where the environment is impaired but property is not affected (Tromans, S. in Mushkat, 1993: 180).

Legislation that promote the participation of "all concerned citizens" in environmental decision-making and implementation, and the provision of facilities to allow the public to mobilize itself to effect political change consistent with sustainable development are all essential. The encouragement of open debate on the environmental implications of national policies (combined with the safeguarding of rights to free expression and other related rights) is also critical along with increased consultation and cooperation among all sectors of society in developing and implementing national strategies which support sustainable development.

Of potential utility in fostering public participation is the mechanism of environmental impact assessment designed to consider the impacts and risks of policies, projects or facilities that may adversely affect the environment. Its effectiveness, however, hinges on the availability of opportunities for meaningful stakeholder involvement in the process as well as on the existence of appropriate legal remedies and redress. Public participation in the EIA process should be mandated by law.

The incorporation of "civic education" in environmental law is also critical in helping national civil society organizations define and implement country-specific programmes that build social cohesion, help resolve conflicts, cultivate people's awareness of their rights and responsibilities and nurture participation in development. Another important process that indirectly contributes to public participation and civic education include the involvement of the media in publicizing cases of environmental degradation and of events that violate the environmental laws. This is necessary for increasing public awareness on the issues of the environment and environmental law.

The Internet can also be used as a tool to provide information to the public on environmental issues and environment-related laws. The Internet can be used as a source of information for the government, businesses and other civil society organizations; and as a tool for networking, bringing a diverse range of people together in Internet conferences and e-mail discussion lists.

4.5.5 Capacity building

As a result of the initiation of the decentralization process, increasing numbers of local government are faced with new and expanded responsibilities and central government with changed responsibilities. Many lack the required capacity to cope with these responsibilities and building capacity therefore assumes fundamental importance. In addition, governments are increasingly expected to work in partnership with the other actors - the private sector, international agencies, community-based organisations, non-governmental organisations. This requires the adoption of new ways of working and building up the capacity to work together effectively. Capacity building is, however, necessary not only for the public sector but also for the other partners (Peltenburg, et. al., 1996). For example, if the government wishes to involve the communities in the monitoring process, it is important to empower and train local communities so that they are equipped with the appropriate tools to monitor their environment.

Lack of environmental awareness has been identified as one of the concerns. Since the environment is often under-valued, awareness building is essential to nurture people's appreciation of the environment. Furthermore, the implementation of environmental measures still depends on the interest, understanding and willingness of the individual staff members in all sector and at all levels. Training and capacity building can play an important part in changing attitudes. At the same time, there is a need to go beyond environmental awareness, to impart skills which can translate this awareness into concrete practice. The skills required should not only be managerial but also include the better understanding of environmental science, especially since scientific evidence is crucial when proving environmental damage. The methodology of doing so is important in capacity building. Therefore, it is crucial that policies promote capacity building strategies which are integrated from the start with environmental management. Environmental legislations should be formulated such that this is mandated. Local contribution to payment for capacity building services should be encouraged to sustain capacity building initiatives as well as ensure that participants take it seriously. It is also important to undertake capacity building activities in a manner that integrates human

resources development, institutional changes and the improvement of an integrated system of organizational and legal frameworks (Peltenburg, et. al., 1996).

The nature of capacity building should ultimately be defined locally and should include key strategic areas, such as: participatory planning and decision-making tools and political processes which facilitate the development of common vision, articulation of needs and joint action; effective, efficient and transparent management and resourcing; developing partnerships and working with government, elected officials, civic and business communities; and monitoring, evaluation and impact assessment (Peltenburg, et. al., 1996). Environmental laws that support a policy framework where the procedures are implemented in an environmentally-conscious manner are crucial for supporting capacity building efforts and retaining and applying the knowledge and skills learned. (Levy, 1996).

4.5.6 *The influence of culture*

Like most governmental functions, environmental management requires a high degree of cooperation from individual citizens with respect to general legal compliance. Cooperation is built upon some measures of approval of actions of management, though not necessarily of their declared objectives. For example, solid waste collection systems may assume that residents will gather together household waste and set it out for collection rather than disperse waste on common land. The extent to which all households do this is a matter of shared attitudes (Mattingly, 1995). Similarly, citizen attitudes toward governmental authority and expectations of government responsibilities are also culturally influenced. These attitudes have direct bearing upon the success of implementing environmental legislation. The community's, country's and region's culture, including their values, customs and belief systems need to be taken into consideration when laws are being established.

Studies on culture and law in the Philippines show that Filipinos fear "losing face" (Oposa, 1996). Therefore an effective way of forcing compliance is to use media to "make one lose face". For example, the Super Mahogany Plywood Corporation in Butuan City, Philippines was charged on August 13, 1992 with illegal commercial logging. The Department of Environment and Natural Resources (DENR), the National Bureau of Investigation (NBI), NGOs and the media together visited the corporation geared with a notebook computer, printer and photo-video equipment. Instead of taking the suspects directly to the investigating magistrate, legal proceedings were conducted on site. No more than five hours after their arrest, the violators were legally taken to jail and their pictures taken behind bars were widely published in national newspapers (Oposa, 1996).

4.5.7 *Impact of policy alternatives: barriers to implementation*

Despite the enactment of numerous environmental laws in most Asia-Pacific countries, the prevailing macro-economic policy relegates the institutionalization of environmental concerns into peripheral and under-resourced organizations. There are bureaucratic resistance to prioritizing environmental issues because environmental protection continues to be regarded as an antithesis to economic progress and political stability. However, there have recently been many initiatives that focus on awareness raising and capacity building of organizations and individuals at all levels, which may change attitudes towards environmental protection with economic development. Nonetheless, it cannot be assumed that an institution that is environmentally-aware (because majority of those working within the institution recognize the importance of environment) will act in an "environmentally conscious" manner as part of their regular practice - in policy and planning, implementation, operation and maintenance, and monitoring processes. The process of transforming environmental concepts into action requires the creation of a need in people for protecting and conserving the environment, as well as an institutional capacity for meeting such needs.

To date, in many countries in the Asia-Pacific region, all that exist are broad statutory and policy statements, enacted from a top-down approach with little or no consultation and dialogue with stakeholders in the respective countries or communities. Legislations are often replicated from the Western legal framework. The adopted environmental legislation lack specific goals and priorities and the country may not have developed the relevant planning procedures and management support structures necessary to transform environmental issues into practice. There may be problems of articulating context-specific laws and policies due to a lack of experience in environmental management. Where goals, objectives and strategies have been defined there is often a lack of internal consistency within and between institutions.

It is important to note that authorities have their own responsibilities, which may not be compatible with the concerns of the communities and the private sector. The private sector and the communities tend to be concerned with the problems within their immediate

vicinity. Balancing the city's wider problems with those of the communities is a precarious activity. To further complicate the situation, the community and the authorities are often internally divided with factions having different interests and degrees of power. The government may see stakeholder participation as a subversive activity and unsupportive of such endeavor. This can sometimes lead to the political alienation of other stakeholders. The unwillingness of government officials to work in partnership with other stakeholders is often caused by the notion that by doing so they are giving up power. Government officials need to be convinced that the process of stakeholder participation and decentralization complements rather than replaces their role. Flexibility in the legal and political framework is an important component of stakeholder involvement where decisions and plans can be altered according to the current and diverse needs of the stakeholders.

4.5.8 Conclusion

Besides the command and control approach, market oriented approach using economic instruments, decentralization and the privatization of public services have also been applied for environmental protection. There has also been a shift towards involving the public in protecting the environment in areas that were previously the responsibility of the State. But environmental legislations in the Asia-Pacific region are by no means complete. The legislatures and policy-makers need to be flexible in their incorporation of new and innovative legislations, policies and strategic actions. The bottom line is that environmental improvement must be linked inextricably to development in any comprehensive national policy.

There needs to be a change in the role of the government from a strictly command and control approach to the inclusion of cultural influences of the individual country and region and innovative economic instruments in legislation. Moreover, the government needs to facilitate and coordinate stakeholder participation in implementing, monitoring and decision-making processes. The creation and maintenance of an enabling environment to attract private investments and nurture enterprises, using appropriate laws, fiscal and monetary policies and stable long-term development strategies, should be made a priority. In addition, the poor income communities, which are more often than not neglected, should, by law, have a role to play in the decision-making process.

Notwithstanding a treaty undertaking "to organize participation of the public", efforts at democratization of environmental decision-making and implementation in the Asia-Pacific region have been rather limited. Whether as a consequence of the colonial legacy or regional cultural influences, top-down decision-making is still the norm. Even where some demand for reform is evident, the desired institutions are slow to evolve (as a result of friction with authorities). The formation of high-level environmental agencies is one of the marked developments in the region. However, many of these agencies lack power, are under-funded, inadequately staffed and inefficient. In addition, the proliferation of agencies with overlapping functions provoke serious inter-agency conflicts in policy-making and jurisdiction. At the same time, the lack of coordination between environmental agencies and other government departments has meant that environmental institutions have little to say in the formulation of national economic plans.

In the Asia-Pacific region, accountability to the public or scrutiny of the exercise of official discretion is minimal or non-existent. For example, while EIAs as an integral part of project planning have been adopted by most countries in the region, the relevant provisions fall short of defining the public's role in the process. No mechanisms are instituted for rigorous public scrutiny or judicial review.

It has become clear more than ever that environmental issues are intrinsically linked with all other factors in contemporary world politics. The environment is a cross-cutting issue that requires mainstream integration into regular practice. Environmental law should fundamentally reflect and reinforce the mainstreaming of the environment. This should include the allocation of resources and the organization of policy for environmental issues, in the context of sustainable development. Environmental law should support civil society organizations that have played and continue to play an important part in putting the environment into the political and legal agenda. Since the environment is a relatively new issue in most Asia-Pacific countries, legislation should promote and guide the course of actions necessary to translate environmental laws into processes, procedures and methods, through research, pilot projects and capacity building.

REFERENCES

ADB (1994b). The Environment Program: Past, Present and Future, Asian Development Bank, Manila

ADB (1997). Emerging Asia: Changes and Challenges, Asian Development Bank, Manila

Ali, (1994)- Ali A. (1996), Vulnerability of Bangladesh to Climatic Change and Sea Level Rise Through Tropical Cyclones and Storm Surges, Water, Air, and Soil Pollution, 92(1-20): 171-179

ASEAN (1997). First ASEAN State of the Environment Report, ASEAN Secretariat, Jakarta, Indonesia.

Australia State of Environment, 1996

Commonwealth of Australia (1996). Australia: State of the Environment 1996, CSIRO Publishing, Collingwood, Australia

Commonwealth of Australia (1997b). Climate Change, Australia's Second National Report Under the United Nations Framework Convention on Climate Change, Environment Australia, Canberra, Australia

Commonwealth of Australia (1998b). Playing our Part, Australia's Actions to Reduce Global Warming: Outcomes from Kyoto and the Implications for Australia. Australian Greenhouse Office, Canberra, Australia

Dutta A K, and Rao J M. (1996). Growth, Distribution and Environment: Sustainable Development in India, World Development, 24(2): 287-305

EA (1997). Quality of the Environment in Japan 1997, Environment Agency, Government of Japan

ESCAP (1990). State of Environment in Asia and the Pacific 1990, Bangkok, Thailand

ESCAP, 1994

ESCAP (1995). State of the Environment in Asia and the Pacific 1995, Bangkok, Thailand

Goldman, R. (1997). Agriculture and Growth in Asia, Background Paper for Emerging Asia: Changes and Challenges, Asian Development Bank, Manila

Government of Maldives (1994). State of the Environment Maldives 1994, Ministry of Planning, Human Resources and the Environment, Male, Republic of Maldives

Hunter, D., Sommer, J. & Vaughan, S. (1994). Concepts and Principles of International Environmental Law: An Introduction, United Nations Environment Programme, Geneva.

JEC (Japan Environmental Council) (1997). Asian Environmental Report 1997/98 (in Japanese)

Levy, 1996

Mattingly, M. (1995). "Urban Management in Less Developed Countries," Development Planning Unit (DPU) Working Paper No. 72, DPU, London.

MoE, Singapore (1998).- Government of Singapore (1998), Make Green Label Your Choice, pamphlet printed by Ministry of the Environment, Singapore

Moser, C. (1989). "Community Participation in Urban Projects in the Third World," Progress in Planning, Vol. 32, Part 2.

MoSTE (Ministry of Science, Technology & Environment) (1997). Thailand's Action for Sustainable Development, Thailand's Country Report to UN Commission on Sustainable Development, p 28-30, Thailand

MoSTE/OEPP, Thailand, 1998

MoSTE, Vietnam, (1998).- MoSTE Viet Nam (1997). State of the Environment Report of Viet Nam 1994, Ministry of Science, Technology and Environment (MoSTE), Viet Nam

MRC/UNEP (1997a). Greater Mekong Subregion: State of the Environment Report, Mekong River Commission, Bangkok, Thailand

MRC (1997b).- MRC/UNEP (1997b). Mekong River Basin Diagnostic Study: Final Report, Mekong River Commission, Bangkok, Thailand

Murthy and Anjaneyule, 1996

Mushkat, R. (1993). "Environmental Sustainability: A Perspective from the Asia-Pacific Region," U.B.C. Law Review, Vol. 27: 153-187

New Zealand GEO-2 Input, 1998

O'Conner, D. (1996). Applying Economic Instruments in Developing Countries: From Theory to Implementation, a paper prepared for EEPSEA, IDRC.

OECD (1998). Environmental Performance Reviews: Australia, Paris, France

Oposa, A.A. (1996). "Legal Marketing of Environmental Law," Duke Journal of Comparative & International Law, Vol. 6:229: 273-290.

Panayotou, T (1994). Economic Instruments for Environmental Management and Sustainable Development, a report submitted to UNEP.

Peltenburg, M., Davidson, F., Teerlink, H., Wakely, P. (1996). Building Capacity for Better Cities, Institute for Housing and Urban Development Studies, The Netherlands. Phantumvanit, D. & Hunt, P. (undated). "Business Solutions to the Urban Challenge," [unpublished].

Rao, Y.S. (1994). Asia-Pacific Tropical Forest: Ecological Disaster or Sustainable Growth, RAPA Publication 1994/18, FAO, Bangkok

Reyes, J.L. (1998). "Integrating Socio-Economic Policies in Strategic Environmental Planning: UNDP Perspective and Experience in Asia-Pacific," paper presented at the "regional meeting on strategic environmental planning" at ESCAP, Bangkok, 25-27 March 1998].

Ryan, J.C. (1992). Conserving Biological Diversity, In: L. Brown, et. al., State of the World 1992, W.W. Nortonne and Co., N.Y., USA

SCARM (1998). Sustainable Agriculture, Assessing Australia's Recent Performance, Draft Executive Summary, Standing Committee on Agricultural Resource Management, DPIE, Canberra, Australia

SEPA (1998). SEPA (1996). Report on the State of the Environment in China 1996, SEPA, China

Sharma, 1993

Shrestha R M and Malla S. (1996). Air Pollution from Energy Use in a Developing Country City: the Case of Kathmandu Valley, Nepal, Energy - The International Journal, 21 (9): 785-794

Singh and Sachdeva, 1996

Statistics New Zealand (1996). New Zealand Official Yearbook 1996, Wellingtonne Turner, S. (1995) Restoring Seagrass Systems in New Zealand, Water & Atmosphere, Vol 3 (2): pp 9-11

TEI (1997). Thailand Environment Directory 1997-2540, Thailand Environment Institute (TEI), Bangkok.

Tromans, S. in Mushkat, 1993: 180

UN (1995). World Urbanization Prospectus 1994, UN Population Division, New York

UN (2000). Ministerial Conference On Environment and Development

UNDP (1997). Governance for sustainable human development, United Nations Development Programme (UNDP), New York.

UNEP (1997). Global Environment Outlook (GEO-1) 1997, UNEP, Nairobi, Kenya

World Bank (1997b). Environment Matters: Towards Environmentally and Socially Sustainable Development, The World Bank Group, Washingtonne, D.C.

World Bank (1997c). RAINS-ASIA: An Assessment Model for Acid Deposition in Asia, Washingtonne, D.C.

WRI/UNEP/UNDP (1992), World Resources 1992-93: A Guide to the World Environment, Oxford University Press, New York and London

Annexures

Appendix 1

ACRONYMS

ADB	Asian Development Bank
AIT	Asian Institute of Technology
ANGOC	Asian NGO Coalition for Agrarian Reform and Rural Development
APPEN	Asia Pacific People's Environment Network
ASEAN	Association of South-East Asian Nations
ASOEN	ASEAN Senior Officials on the Environment
AusAID	Australian Agency for International Development
CFC	Chlorofluorocarbon
CGIAR	Consultative Group on International Agricultural Research
CSE	Centre for Science and Environment, India
CSIRO	Commonwealth Scientific and Industrial Research Organisation, Australia
DEIA	Division of Environment Information and Assessment of UNEP
EA	Environment Agency, Japan
EAP-AP	Environment Assessment Programme (of UNEP) for Asia and the Pacific
EEPSEA	Economy and Environment Programme for Southeast Asia
EGAT	Electricity Generating Authority, Thailand
EIA	Environmental Impact Assessment
ESCAP	Economic and Social Commission for Asia and the Pacific of the UN
FAO	Food and Agriculture Organization of the UN
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GEMS	Global Environment Monitoring System
GEO	Global Environment Outlook
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environment Protection
GLASOD	Global Assessment of Soil Degradation
GMS	Greater Mekong Sub-region
GNP	Gross National Product
ICIMOD	International Centre for Integrated Mountain Development
ICOLD	International Commission on Large Dams
IDE	Institute of Developing Economies
IUCN	World Conservation Union
JEA	Japan Environment Associations
JEC	Japan Environment Council
MoE	Ministry of Environment
MoSTE	Ministry of Science, Technology and Environment of Thailand
MRC	Mekong River Commission
MRLC	Mekong Region Law Centre
NCEA	National Commission for Environmental Affairs, Myanmar
NEB	National Environment Board
NEERI	National Environmental Engineering Research Institute, India
NETTLAP	Asia Pacific Network for Tertiary Level Environmental Training
NESDB	National Economic and Social Development Board
NGO	Non-governmental Organization
NIES	National Institute of Environmental Studies, Japan
NOx	nitrogen oxides
OECD	Organization for Economic Co-operation and Development
OEPP	Office of Environmental Policy and Planning, Thailand

SACEP	South Asia Cooperative Environment Programme
SEPA	State Environmental Protection Administration, China
SoE	State of the Environment
SPREP	South Pacific Regional Environment Programme
TEI	Thailand Environment Institute
TERI	Tata Energy Research Institute
UN	United Nations
UNCSD	United Nations Commission on Sustainable Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP/ROAP	United Nations Environment Programme, Regional Office for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFIP	United Nations Fund for International Partnership
WB	World Bank
WCMC	World Conservation Monitoring Centre
WHO	World Health Organization
WRI	World Resources Institute
WWF	World Wide Fund

Appendix 2

INTERNATIONAL GEO 2 (ASIA-PACIFIC) CONSULTATION

ASIA-PACIFIC GEO CONSULTATIONS

South Asia Consultation, Nagarkot, Nepal, 19-20 May 1998.

Mr. Abdul Khaleque, Ministry of Environment and Forest, People's Republic of Bangladesh; Mr. Karma C. Nyedrup, National Environment Commission, Bhutan; Mrs. Usha Subramaniam, Ministry of Environment & Forests, India; Mrs. Mahshid Agir, Department of the Environment, Islamic Republic of Iran; Mr. Ahmed Ali Manik, Ministry of Planning, Human Resources & Environment, Republic of Maldives; Mr. S.B. Sharma, MoPE, Nepal; Mr. Purushotam Kunwar, MoPE, Nepal; Mr. Batu Krishna Upreti, MoPE, Nepal; Raja M. Ashfaq, Pakistan Forest Institute, Pakistan; Prof. Luan Shengji, Peking University, China; Dr. Muhammad Eusuf, Bangladesh Centre for Advanced Studies (BCAS), Bangladesh; Dr. Shiro Hatakeyama, National Institute for Environment Studies (NIES), Japan; Mr. Vishal Narain, Tata Energy Research Institute (TERI) - GEO-2 Collaborating Centre, India; Dr. Somrudee Nicro, Thailand Environment Institute (TEI) - GEO2 Collaborating Centre, Thailand; Dr. Ram Manohar Shrestha, Asian Institute of Technology (AIT) - GEO-2 Collaborating Centre, Thailand; Dr. Monthip Tabucanon, Environmental Research and Training Center (ERTC), Thailand; Mr. R. Rajamani, IAS, Facilitator, MoE & F, Government of India; Dr. Ananda Raj Joshi, South Asia Co-operative Environment Programme, Sir Lanka; Mr. Pradyumna Kumar Kotta, South Asia Co-operative Environment Programme, Sir Lanka; Dr. Mahesh Banskota, International Centre for Integrated Mountain Development (ICIMOD), Nepal; Mr. Pramod Pradhan, International Centre for Integrated Mountain Development (ICIMOD), Nepal; Mr. Basanta Shrestha, ICIMOD, Nepal; Surendra Shrestha, UNEP/EAP-AP, Thailand; Choudhury Rudra Charan Mohanty, UNEP/EAP-AP, Thailand; Mylvakanam Iyngararasan, UNEP/EAP-AP, Thailand; Diwakar Dahal, UNEP/EAP-AP, Thailand.

South East Asia Consultation, Bangkok, Thailand, 25-26 May 1998.

Dato' Paduka HJ Othman B HJ Yaakub, Ministry of Development, Brunei Darussalam; H.E. Mr. Harry Harsono Amir, Ministry of Development, Indonesia; Mr. Phonechaleun Nonthaxay, Science, Technology, and Environment Organization (STENO), Lao PDR; Mr. Azhar Bin Noraine, Ministry of Science, Technology, and Environment, Malaysia; Ms. Daw Yin Yin Lay, Ministry of Foreign Affairs, Myanmar; Dr. Delfin J. Ganapin Jr, Department of Environment and Natural Resources, Philippines; Ms. CHENG Geok Ling, Ministry of the Environment, Singapore; Dr. Allan Haines, Environment Priority and Coordination Group, Australia; Dr. Denise Church, Ministry for the Environment, New Zealand; Dr. Jarupong Boon-Long, Pollution Control Department, Thailand; Dr. Wanee Samphantharak, Office for Environmental Policy and Planning (OEPP), Thailand; Mr. Surasit Chaiyaphum, Office for Environmental Policy and Planning (OEPP), Thailand; Mr. Warasak Phuangcharoen, Office for Environmental Policy and Planning (OEPP), Thailand; Dr. Monthip Sriratana Tabucanon, Environmental Research and Training Centre (ERTC), Thailand; Mrs. Nguyen Thi Tho, Ministry of Science, Technology, and Environment (MoSTE), Viet Nam; Mr. Apichai Sunchindah, The ASEAN Secretariat, Indonesia; Mr. R. Rajamani, MoE & F, Government of India; Dr. Atiq Rahman, Bangladesh Centre for Advanced Studies (BCAS), Bangladesh; Dr. Yue Ruisheng,, SEPA, China; Dr. Shiro Hatakeyama, National Institute for Environment Studies (NIES), Japan; Mr. Vishal Narain, Tata Energy Research Institute (TERI) - GEO-2 Collaborating Centre, India; Dr. Somrudee Nicro, Thailand Environment Institute (TEI) - GEO2 Collaborating Centre, Thailand; Dr. Ram Manohar Shrestha, Asian Institute of Technology (AIT) - GEO-2 Collaborating Centre, Thailand; Mr. Taka Hiraishi, United Nations Environment Programme (UNEP), Kenya; Dr. Suvit Yodmani, UNEP Regional Office for Asia and the Pacific (ROAP), Thailand; Surendra Shrestha, UNEP/EAP-AP, Thailand; Choudhury Rudra Charan Mohanty, UNEP/EAP-AP, Thailand; Mylvakanam Iyngararasan, UNEP/EAP-AP, Thailand; Diwakar Dahal, UNEP/EAP-AP, Thailand; Ms. Wantanee Katepasook, UNEP Regional Office for Asia and the Pacific (ROAP), Thailand.

Greater Mekong Sub-region Consultation, Bangkok, Thailand, 27 May 1998.

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Appendix 3

SUB-REGIONAL BREAKDOWN AND ORGANIZATIONS

South Asia (SACEP):
Afghanistan, Bangladesh, Bhutan, India, Islamic Republic of Iran, Maldives, Nepal, Pakistan, Sri Lanka

South East Asia (ASEAN):
Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Lao PDR, Thailand *, Myanmar *, Cambodia *

Greater Mekong Sub-region (GMS/MRC):
China (only Yunnan Province), Lao PDR, Viet Nam, Thailand *, Myanmar *, Cambodia *

North West Pacific and East Asia (NOWPAP):
China, DPR Korea, Japan, Republic of Korea, Mongolia, Russian Federation

Australasia and the Pacific (SPREP):
American Samoa (USA), Australia, Cook Islands, Fiji, French Polynesia (FR), Guam (USA), Kiribati, Micronesia, Marshall Islands, Nauru, New Caledonia (FR), New Zealand, Northern Mariana Islands (USA), Niue, Papua New Guinea, Pitcairn Islands (UK), Republic of Palau, Solomon Islands, Tokelau (NZ), Tonga, Tuvalu, Vanuatu, Wallis and Futuna (FR), Western Samoa

Note: ** Thailand, Myanmar and Cambodia falls in both GMS & ASEAN*

Appendix 4

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