State of the Environment

South Asia 2001

SACEP

NORAD
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NORWEGIAN AGENCY FOR DEVELOPMENT COOPERATION

UNEP

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FOREWORD

Executive Director
United Nations Environment Programme

The Rio Earth Summit in 1992 formulated an action plan, Agenda 21, a multifaceted process to address the full range of development and environmental issues involving participation of governments, international organizations and major groups in the quest for sustainable development

The publication of the Global Environmental Outlook series, GEO-1, followed by GEO-2000, the Millennium Report on the Environment, involved a participatory assessment process to review the state of the world's environment and to chart a new process for global environmental policy. The diversity and magnitude of environmental problems are outlined, with a call for more complete and precise analyses of the poorly understood linkages between human actions and environmental outcomes. Although the number of policy responses is growing, low priority continues to be afforded to the environment in national and regional planning. GEO-2000 stressed the need for the development of more comprehensive and long-term mechanisms for monitoring and assessing the effects of environmental policies on environmental quality; and for more integrated policy making and action-based programmes to serve the needs of the people.

The United Nations Environment Programme (UNEP) is mandated to produce a Global State of the Environment Report in 2002 (GEO-3) for the 2002 Earth Summit i.e., Rio + 10, and this global assessment will be enriched by producing State of Environment (SoE) reports at the national, subregional and regional levels. In 1998, the UNEP Regional Resource Centre for Asia-Pacific (UNEP RRC.AP) collaborated with the Norwegian Agency for Development Cooperation (NORAD) to carry out a process on Strengthening National Capabilities on Environment Assessment and Monitoring towards the Preparation of the Global State of the Environment Report 2002, thus linking national to regional and global initiatives.

This sub-regional State of the Environment (SoE) Report is the first of such assessment resulted from the above process focusing on South Asian region (Bangladesh, Bhutan, India, Iran, Maldives, Nepal and Sri Lanka). The report was prepared through a consultative and participatory process soliciting input from various government agencies, NGOs, and intergovernmental organizations. With the substantive support from Development Alternatives (DA), the designated regional Collaborating Center, and regular feedback and support from the South Asia Cooperative Environment Programme (SACEP), this assessment exercise has been successful and instrumental in providing significant input to the on-going GEO-3 and 2002 WSSD preparatory process. It aims at providing guidelines for environmental action planning, policy setting and resource allocation for the coming decades, based on a sound analysis of the state of, and trends in, the region's environment.

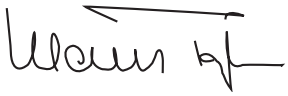
The report elaborates and analyzes the priorities and key issues from the array of environmental concerns facing the region. The report addresses five key environmental issues of South Asian countries such as (1) livelihood security (food, water, energy, and income), (2) environmental disasters (trends of occurrence, impact on biodiversity, loss incurred), (3) industrializations (growth, distribution, and waste generation), (4) urbanization (growth of cities, migration, population, and economic growth), and (5) loss of biodiversity. The report also analyzes an over all situation highlighting emerging environmental trends/priorities that require strengthened international and regional policy measures and action.

The region's state of the environment suffers from excessive land degradation, desertification, and habitat fragmentation. Increasing habitat fragmentation has depleted the wide variety of forest products that used to be an important source of food, medicine and income for indigenous people. Urbanization and poverty is an important challenge in most of the South Asian cities. Freshwater supply problem in urban centers is compounded by high urban population growth rate. South Asia has been experiencing a region-wide structural shift towards increased

industrialization. This shift on dependence to industrial sector has given rise to a number of environmental problems. Energy demand is fast rising. One of the major concerns is that the South Asian countries still depend on coal for production of electricity and to meet the energy requirement for the industrial sectors. Heavy reliance on coal has translated in to significant increases in the emission of air pollutants. One of the greatest challenge the region faces is to promote trade liberalization along with the protection of the environment and natural resources. The region today has to strike a balance between development and environment to ensure the path of sustainable development for the coming decades. The key institutions such as SAARC, SACEP, and ICIMOD, and the policy makers of the region need to look into the environmental dimensions of socio-economic development as well as the socio-economic dimensions of environmental degradation. A number of initiatives and sub-regional cooperation are, however, observed in relation to achieving sustainable development in the region.

This SoE assessment for South Asia provides a sound basis for the development of action plans, the next stage of the planning process, as we progress in the twenty-first century. The report aims to provide concrete guidance for action planning, policy setting and resource allocation for the coming decades to improve the state of the environment of South Asia and the welfare of the region's people.

UNEP will continue to contribute to the preparation of environmental assessment reports at national, sub-regional, and regional level and the capacity building necessary to support these assessment activities.



Klaus Töpfer
United Nations Under-Secretary General and Executive Director
United Nations Environment Programme
December 2001

FOREWORD

Director General
SACEP

State of the Environment (SoE) reporting at the national, regional and global level is now a well-recognized activity. It is also a legislative requirement in many countries. SoEs have a great value for the decision-making in the government and participation of civil society organizations and the public in formulating policies and programmes for environmental protection and sustainable development.

At the sub-regional level, South Asia Co-operative Environment Programme has actively collaborated with UNEP and the National Governments in the preparation of National and South Asia SoE Reports. The current series of National SoE Reports follow Pressure-State-Impact-Response (P-S-I-R) framework recommended by the Commission on Sustainable Development. Synthesis of these reports at sub-regional level therefore focuses on the key prioritized environmental issues of the region.

The SoE South Asia Report is an effort to document emerging environmental trends and priorities of the region requiring remedial measures at various levels. This Report has been produced by the Development Alternatives in close consultation with all stakeholders and collaborating centers within the region. The Report addresses the insecurity levels and clearly puts forward the diversity and magnitude of environmental problems, the related human actions and the environmental trends that need a serious attention. This assessment and the National SoE Report for South Asia will provide a sound basis for the development of action plans, aimed at mitigating enumerated problems of the South Asian countries.

I am very pleased that we have succeeded in meeting our obligation of assisting the countries to achieve the goals of sustainable development through the SoE Reporting. SACEP wishes to place on record the generous financial and technical support received from UNEP and NORAD towards this effort.

Mahboob Elahi
Director General
South Asia Cooperative Environment Programme (SACEP)

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SEAMCAP Project Facilitator
Raghunathan Rajamani

SEAMCAP Project Team

UNEP RRC.AP
Surendra Shrestha
Choudhury Rudra Charan Mohanty
May Ann Mamicpic-Bernardo
Mylvakanam Iyngararasan
Purna Chandra Lall Rajbhandari

SACEP
Mehboob Elahi
Pradyumna Kumar Kotta

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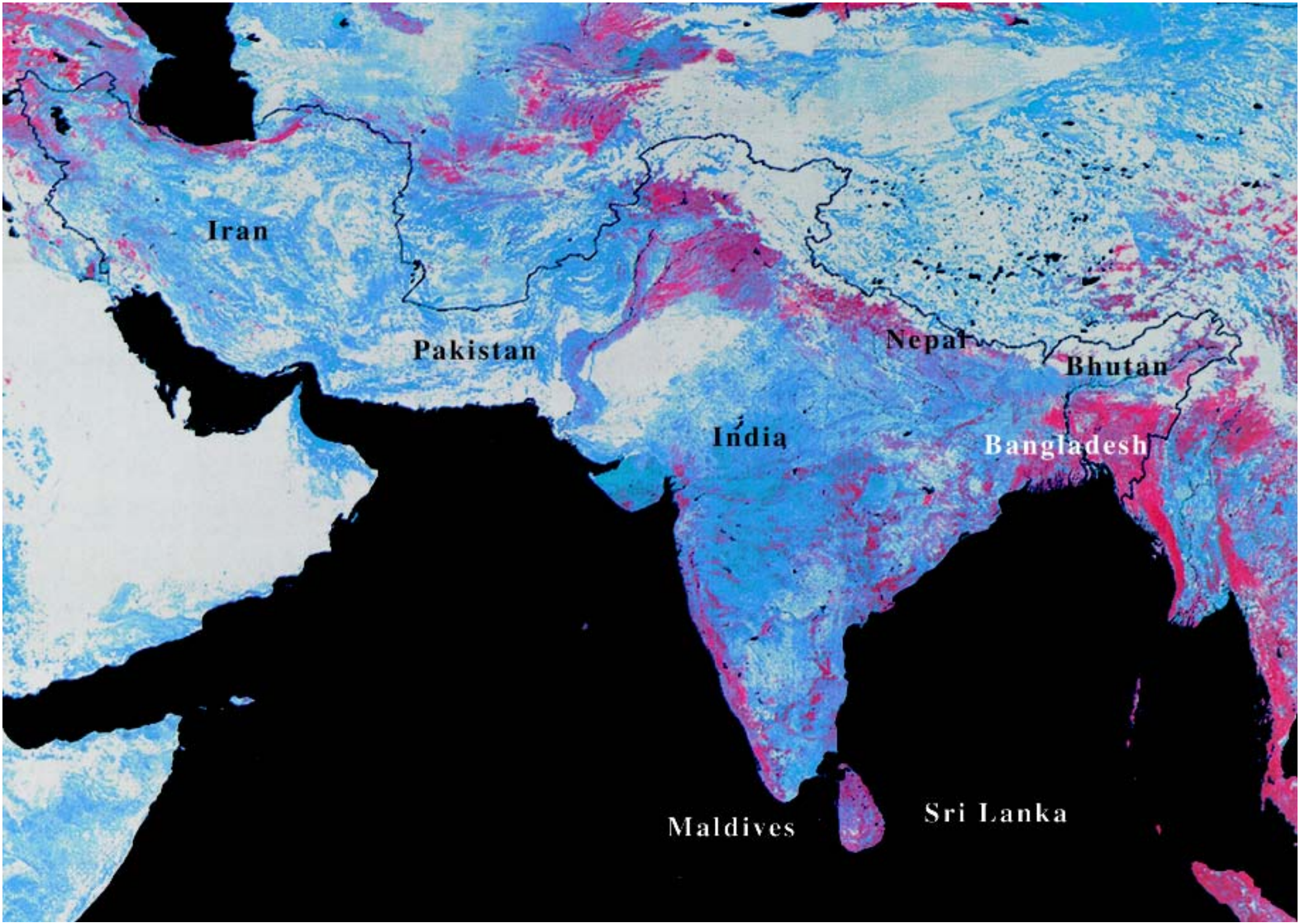
Regional Overview

A discussion of the existing biophysical profile, socio-economic and cultural patterns, political and governance structures and the economic base of the South Asian region.


Iran
Pakistan
Nepal
Bhutan
India
Bangladesh
Maldives
Sri Lanka

1.0 Biophysical Profile

The South Asian region, spans an area of about 4,29,16,000 sq km and accounts for a population of about 1.36 billion. Out of this the countries Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka cover an area of about 41,26,800 sq km and a population of about 1.3 billion and Iran accounts for 16,48,000 sq km and houses a population of 60 million.

1.1 Biogeophysical Zoning

South Asia is bounded in the south by the Indian Ocean, in the south-east by the Bay of Bengal and in the south-west by the Arabian Sea. Occupying a major portion of the Indo-Malayan realm and a smaller portion of the Palaearctic realm, this region is representative of five of the fourteen major ecological regions called 'biomes', which demonstrate the biodiversity and vegetation patterns of this region as determined by climate, water, geology, soil and diverse topography.

1.2 Physiography and Relief

Unlike the other continents, South Asia's topography consists of an amazing variety of mountains, plateaus, dry regions, intervening structural basins, etc. The diversity in the region's physiography is exhibited in some of the most spectacular natural sites - the Sagarmatha (Mount Everest), the world's highest mountain, in Nepal; Sunderbans, the largest mangrove swamp in the world shared by India and Bangladesh; the temperate forests in Bhutan; the deserts and arid regions of north-west India (Thar) and south Pakistan; high altitude cold deserts; major plateau regions in south India and the Arabian Peninsula; great structural basins and river plains; and beautiful coral reef lagoons and atolls in Maldives and the Lakshadweep islands (India), which dot the Indian Ocean, and the Andaman islands (India) in the Bay of Bengal.

The South Asian region, in general, slopes from the north to the east and the west. While the north-western part is home to the flat Indus plains and the Baluchistan plateau, partly covered by deserts, the rugged Himalayas in northern India tower over the flat plains - called terai - along the river Ganga. The Himalayas comprise of three ranges: the Outer Himalayas, the Lesser Himalayas, and the Tehtys or the Tibetan Himalayas. Together, these ranges form an imposing east-west arc, some 2,500 km (about 1,550 miles) in length, containing numerous peaks which are more than 6,100 m in height, including the Mt. Everest.

The kingdom of Bhutan in the north is mostly mountainous (with a few fertile valleys and savannas), while southern India rests on the relatively flatter Deccan plateau. Sri Lanka, on the other hand, is a tropical island with three-quarters of plains in the south, and massive mountains covering the rest of its land area. Maldives, at the southern end of the region, is a country of low-lying islands rich in corals.

The region has a long stretch of coastline extending to about 10,000 km from Pakistan to Bangladesh.

Climate

A monsoon climate, characterised by wet summers and dry winters, generally prevails over South Asia. The south-west monsoons (late May to October) bring the maximum rainfall to the region, followed by the north-east monsoons. Due to the variations in land forms, precipitation and climate vary significantly from place to place in different countries within the region. For instance, rainfall ranges from 200 mm in the desert areas of the north-west to 4,000 mm in the Higher Himalayas of Bhutan.

Cyclones, brought forth by the south-west monsoons, are a common phenomenon in coastal areas of India, Bangladesh and Sri Lanka. The differential heating by the Central Asian land mass and cooling by the Indian Ocean water mass cause moisture-laden air from the ocean to move towards the Indian subcontinent, from a region of high pressure to one of low pressure. This gives rise to the cyclones.

The climate also varies from the semi-arid in Pakistan to the tropical monsoon and hot-dry, humid-dry in the rest of the region. However, localised climatic conditions prevail in hilly regions. The region also witnesses marked variations in temperature as well - ranging from as low as -20°C in the cold deserts to a scorching 48°C in desert areas and some plains.

Mountains

The South Asian region can be divided into two main land units: the ancient land mass of Peninsular India, and the geologically young Himalayas and associated ranges. Peninsular India, including Sri Lanka, consists of a single tectonic structure, the Deccan Plateau, which originally formed a part of Gondwanaland. Deccan is an ancient land mass of Archaean and Pre-Cambrian formations which are exposed over more than half of India. The other ancient mountain ranges are the Aravalli ranges, the Vindhyan ranges, the western edge of the plateau formed by the Western Ghats (Sahyadri mountains), and the eastern edge marked by another range of hills, the Eastern Ghats.

The Himalayas are the product of intense mountain-building activity in the Cretaceous, Tertiary and Pleistocene periods. They extend for 3,200 km from the 'Pamir Knot' on the Afghanistan border in the north-west, across the northern part of the Indian subcontinent in an arc from Jammu and Kashmir, eastwards through Himachal Pradesh, Nepal, Sikkim, the Chumbi Valley (Tibet) and Bhutan, to Arunanchal Pradesh in the east. The main range of the Himalayas (the Great Himalayas) includes, from west to east, the Kashmir Himalayas, the North-west Himalayas, the Kumaon Himalayas, the Nepal Himalayas (which include mountains such as Mount Everest - 8,848 m, Kanchenjunga - 8,579 m, Makalu - 8,470 m, Dhaulagiri - 8,425 m, Annapurna - 8,091 m, and Gosainthan - 8,010 m), and the Assam Himalayas in Sikkim, Bhutan and Arunachal Pradesh. In the west, the Baluchistan arc of the Himalayas runs south-west from Kashmir through Baluchistan to the Arabian Sea.

Rivers

Several important river systems in South Asia originate in upstream countries and then flow to the other countries: the Indus river originates in China and flows to Pakistan; the Ganga-Brahmaputra river systems originate partly in China, Nepal and Bhutan, and flow to India and Bangladesh; some minor rivers drain into Bangladesh and Nepal.

The Indus river is one of the world's greatest, measuring 2,800 km from its source to the sea. Its major tributaries are the Kabul and the Swat (west flowing) and Jhelum, Chenab, Ravi, Beas and Sutlej (east flowing). These tributaries have a total length of about 5,600 km. The Indus basin spans north-western India and Pakistan. The Ganga stretches to about 2,525 km, and the Brahmaputra, the third great Himalayan river, stretches to about 2,900 km flowing through Tibet, India and Bangladesh.

In Sri Lanka, there are 103 rivers draining water in a radial pattern from the high watersheds. The longest river, the Mahaweli, provides water to 16 per cent of the island. The Ganga, Brahmaputra and Meghna are the major rivers in Bangladesh. The Meghna flows south-west, draining eastern Bangladesh and the hills of Assam, Tripura and Meghalaya in India, to join the Padma river at Chandpur. It then flows south for 160 km and discharges into the Bay of Bengal. The rivers in Bhutan are the Jadalkha, Torsa, Raidak, Sankosh, Mao Khola/Aie, and the Manas flowing from west to east. Bhutan's eastern rivers are the Bada, Dhansiri and the Torsa. Maldives does not have any rivers, but small brackish ponds can be found on some islands.

1.3 Land

Vegetation and Forests

The diversity in the latitude, altitude, climate and topography has resulted in a variety of vegetation in the region, ranging from the temperate and the tropical to the dry (desert) vegetation. Forests occupy 18.6 per cent of the total land area of the region and account for 2.73 per cent of the total forest area in the world. Protected areas cover about 5 per cent of the region's land area, offering shelter to some of the most endangered and threatened species of plants and animals.

A monsoon rainfall pattern, which is characteristic and typical of the region, plays a crucial role in determining the vegetation type. The topography and soil type of the region do not have much role to play in determining the vegetation type except in the Himalayan region and the deserts.

The vegetation of the South Asian region is principally distinguished into four types based on rainfall:

- Evergreen forests: regions with more than 2,500 mm rainfall p.a.
- Deciduous monsoon forests: 1,000-2,000 mm p.a.
- Dry forests and scrubland: 500-2,000 mm p.a.
- Desert and semi-desert vegetation: less than 500 mm p.a.

Annex 2 elaborates a list of the forest types, based on the above classification, that are predominant in the region.

Biological Wealth

South Asia houses approximately 15.6 per cent of the world's flora and 12 per cent of its fauna. The faunal diversity of the region comprises of 933 species of mammals, 4,494 of birds, 923 of reptiles, 332 of

amphibians and 342 of freshwater fishes. The floral diversity accounts for 39,875 species of flowering plants, 66 of conifers and cycads, 764 of ferns and 6,652 of higher plants (Biodiversity Data Source Book, 1994). Within the region, India and Nepal occupy 2.5 per cent of the total global land area, and contribute nearly 10 per cent of the global biodiversity. While Nepal's share of land area is only 0.1 per cent of the world land area, it holds 2 per cent of the world's flowering plants.

Within the region, in India and Sri Lanka, three 'biodiversity hot-spots' have been identified out of the 18 in the world. These hotspots are areas with high species diversity and high levels of endemism - areas where the species are subject to exceptional levels of threat. These 'hot-spots' are: the Eastern Himalayas in Nepal, Bhutan and north-east India, the Western Ghats in India and the South-western Ghats of Sri Lanka.

The Sunderbans and tidal forests, extending upto 6,050 sq km and shared between India and Bangladesh, are one of the world's longest stretches of continuous mangroves. Besides harbouring nearly 27 species of plant species and 347 faunal species, the area is known for its famous threatened resident, the Royal Bengal Tiger. These wetlands are a lifeline and source of livelihood for people in the coastal as well as inland areas in the region. These sensitive and productive ecosystems are now under various threats, mainly arising from human pressure.

Grasslands are another productive ecosystem which harbour a great faunal diversity, particularly of birds. However, the grasslands, especially in India, are under heavy pressure of grazing by the burgeoning livestock population. Alpine pastures in the Himalayas are also under threat due to overgrazing.

Nearly 28 sites of the region have been identified as centres of plant diversity and endemism. The region is a repository of several fodder, food and medicinal plants as well as timber, and the centre of origin of several crop plants and their wild relatives which include rice, mango and other fruits, vegetables and ornamental plants.

The faunal diversity of the region is equally impressive and includes five great cats - the lion, tiger, leopard, snow leopard and the clouded leopard, besides eight of the world's 15 species of cranes, few of them highly threatened migrants coming from far lands for nesting in the region. Two of the world's five biggest bustard species, the Great Indian Bustard and the Houbara Bustard, are found in the region.

Some of the highly endangered species that have made this region their home include the Nilgiri Tahr of the Western Ghats, the Indian Wild Ass (which is confined to the Rann of Kuchch in India, the Manipur brow-antlered deer (*Cervus eldi eldi*) which is restricted to a small area of barely 209 sq km in the Loktak Lake region of Manipur and which numbers only 43 at present, and the Asiatic Lion (*Panthera leo persica*) confined to a small patch in the Gir Forests in Gujarat, India. South Asia is the only part of the world which holds all three families of the crocodilian order - the gharial, crocodile, and the alligator. The coasts of this region, particularly those of India, Sri Lanka and the Maldives, are visited by five of the seven highly endangered marine turtle species in the world: the Loggerhead turtle (*Caretta caretta*), Green turtle (*Chelonia mydas*), Hawksbill turtle (*Eretmochelys imbricata*), Olive Ridley turtle (*Lepidochelys olivacea*) and the Leatherback turtle (*Dermochelys coriace*). Elephants in SriLanka and India are also under threat.

In addition to its terrestial biodiversity, the region also has a rich marine biodiversity. The marine ecosystems - coral reefs in particular - are degrading due to increase in ocean temperatures, the combined effects of agricultural run-offs and siltation, urban sewage, industrial pollution, unplanned tourism, increasing population on islands, overfishing and illegal fishing operations, land reclamation, coral mining, rise in sea levels etc. Efforts are on to accord some protection by designating marine protected areas.

The protected species of the region are facing different kinds of threats - from commercial and industrial pressures of logging, development projects, poaching and illegal felling, smuggling of timber, unsustainable extraction of fuelwood and fodder, grazing, mismanaged tourism, drainage of wetlands etc. These are compounded by ineffective and weak legislations, and lack of political commitment towards their enforcement and implementation.

An area of approximately 2,11,000 Sq Km* of the total geographical area of South Asia is presently kept aside for protecting endangered and endemic species of wildlife. Besides the measures taken by the government, the region also has age-old traditional conservation practices, which are still prevalent in certain areas. Traditional forms of protecting sacred groves and caring for specific species is offered mainly by certain communities who have been living in harmony with nature for centuries. These traditions are eroding fast and there is a need to imperatively revive such traditional practices before they are lost forever.

Bhutan is the only country in the South Asian region that has over 20 per cent of its territorial area under protection. Bhutan chose to remain isolated, by deliberate policy, for several years and opened up to the rest of the world only in late 1960s. Taking lessons from its neighboring countries, the government decided to adopt a strict conservationist policy in 1974 which stipulated that 60 per cent of the country should remain under forest cover in perpetuity. To maintain this, the government initiated measures that included banning shifting cultivation, introducing large-scale tree plantation programme, cutting down on the population of goats by four-fifths and restricting them to stalls, and giving patches of forests to villages for maintenance.

Water Bodies

Wetlands in South Asia extend upto 1,34,161 sq km and include floodplains, marshes, estuaries, lagoons, tidal mudflats, reservoirs, rice paddies, saline expanses, freshwater marshes and swamps. Of these, nearly ten have been designated as Ramsar sites of international importance as waterfowl habitats. By virtue of their very specific and unique nature and the specialised biodiversity that they support - including some plant species of medicinal, commercial and economic significance - these wetlands are an important habitat for several millions of people living in their vicinity.

Mineral Wealth

South Asia is endowed with enormous reserves of coal, oil, natural gas, uranium, iron, bauxite and other ores. The geologic diversity explains the abundant reserves of ore. Large offshore reserves are believed to exist along the coasts of Bangladesh and in some pockets of India. India produces 89 minerals out of which four are fuel minerals, 11 are metallic, 52 non-metallic and 22 minor minerals. India ranks third in production of coal, lignite, chromite and barytes; fourth in iron ore; sixth in bauxite and manganese ore; tenth in aluminium; and eleventh in crude steel, besides being the largest producer of mica in the world.

Sri Lanka is famous for precious and semi-precious stones, such as blue sapphire, topaz, aquamarines and zircons. Other important mineral resources include limestone, graphite, mineral sands, phosphates, clay, quartz, apatite and ilmenite. Nepal's mineral reserves include marble, copper, coal, lead, zinc, iron, silica, natural gas and dolomite and semi-precious stones such as tourmaline, garnet and beryl. Bangladesh holds reserves of natural gas, while in Pakistan, limited petroleum, poor quality coal, iron ore, copper, salt and limestone are available.

1.4 Land Use Patterns

Less than two-fifth of South Asia's* land is arable. The percentage of agricultural area has enormously increased in the region since the past one-and-half decades, but in Bangladesh and India, it has shown a decreasing trend. In general, the basic unit of production is the village rather than the farm. In South Asia, agriculture is characterised by small landholdings in alluvial lowlands, too many people on too little land, production largely for subsistence, high rates of tenancy, heavy dependence on cereals and other food staples, and pre-modern technologies. Rice is the staple food crop. It is usually grown under wet conditions. The yields are extremely low, controlled irrigation facilities are poorly developed, and double-cropping is seldom practiced. Irrigation schemes in India have helped stabilise annual yields and increase overall production.

2.0 Socio-Economic and Cultural Patterns

Heritage is an outcome of the socio-cultural statement of people who lived in the past. However, in South Asia, concerns for heritage have been overshadowed by increasing population pressures, growing poverty and a steadily degenerating ecological balance. Large populations settled in and around valuable cultural or religious monuments, that we try to preserve as our Heritage, is not an uncommon sight in the region.

2.1 Socio-cultural Patterns

South Asia is home to one of the oldest civilizations in the world, displaying a multitude of cultures, in which people from different races and religions co-exist. Besides the socio-cultural groups that are native to the region (such as Buddhists and Jains), it also shelters groups which have either immigrated to the land or have come in contact with it. Under Muslim rule, for instance, migrants from Afghanistan, Persia and Central Asia introduced their cultures, literatures, architecture and military practices into the sub-continent, enriching the already high levels of native civilization. All the countries in the region, in turn, share regional cultures with centrally located India.

Religions

Hinduism, Islam, Buddhism, Christianity, Jainism and Sikhism are the principle religions followed here. Hinduism has been the prevalent religion in South Asia for almost 3,500 years. Older forms of religions such as animism, nature worship and totemism also exist today in different forms.

Islam, the predominant religion of Pakistan, Bangladesh and the Maldives, is the second most important religion in South Asia. Buddhism is restricted to Sri Lanka and Bhutan. Christianity, probably introduced in the sub-continent during the third century or even earlier, became a greater influence in India after western occupation. Aboriginal and other tribes embraced Christianity in large numbers in Nagaland, Meghalaya, Mizoram, and the Chotanagpur plateau in Bihar. In Kerala, Goa and other parts of the south Indian coast, western sea-borne contacts resulted in the adoption of Christianity. Moreover, during the colonial period, a large number of Christian males from Europe married native girls and gave rise to a new community of Christians, the Anglo-Indians. In addition to Goa, the cities of Mumbai and Kolkata have large Anglo-India communities.

Sikhism, a religion limited mostly to the state of Punjab where it was founded by Guru Nanak in 1499, contains elements of both Hinduism and Islam. Buddhism and Jainism, which originated in Bihar (India) in the sixth century B.C., also spread widely in India. The northern and eastern frontiers of India have a considerable Buddhist population.

Nepal, Bhutan and Sri Lanka have specific distribution characteristics of different religious groups. In Nepal, the northern high mountain fringe is Buddhist, primarily influenced by Tibetan Buddhism, while traces of Islam are found at the southern fringe where Muslims have penetrated from India's Middle Gangetic Plain. Nonetheless, 87 per cent of Nepal is Hindu. In Bhutan, 20 per cent or more of the population is Buddhist with a strong Tibetan influence. Sri Lanka, on the other hand, is a nation of Buddhists (66 per cent), Hindus (18.5 per cent), Christians (8.4 per cent) and Muslims (6.8 per cent). Among the South Asian countries, it has decidedly the highest religious diversity. All Tamil Sri Lankans, living in the northern part of the island, are Hindu, while the most densely populated south-western area around Colombo is essentially Buddhist.

Pakistan has a primarily Islamic population, but there are about 1 per cent Hindus. It has some Christian and tribal population too. From a religious point of view, it is the most homogeneous country in South Asia.

In Bangladesh, besides Islam, about 12 per cent of the population - distributed throughout the country - follows Hinduism.

Cultural Heritage

In 1986, the UNESCO recognised Khajuraho in India as the 22nd world heritage site. The Taj Mahal, in Agra, India is one of the seven modern wonders of the world. The Okanda-kudumbigala, a sacred grove in Sri Lanka, is another unique landmark of the region. What is disheartening is the degenerating conditions of these sites/monuments of national pride. Monuments built during the Mughal period have endured the

ravages of time and age. But pressures of population and increasing environmental degradation are now posing serious threats to them.

The region's rich heritage is not confined to monuments. It embraces some of the most sought after philosophies and ways of life as well. According to Vaastu Shastra and the Atharva Veda in Hindu tradition, Kurullu Paluwa, Bija and Wagamaruwa in Sri Lanka are some of the established ethno-scientific methods to maintain and improve the quality of life.

2.2 Demographic Trends

Demographers point out that lesser the infant mortality, better the possibility of a decline in fertility rate, because increasing infant survival rate often creates conditions for adoption of family planning methods. Infant mortality declined consistently between 1970-92 in all the South Asian countries. Bhutan and the Maldives continued to have the highest rates, while Sri Lanka had the lowest. The rate of decline was the sharpest for Bangladesh, India and Sri Lanka.

The declining rate, in general, was primarily due to access to better medical care, better sanitation facilities, and improved knowledge of child care. Bangladesh, India, Nepal and Pakistan had similar infant mortality rates during the 22-year period. Pakistan's fertility rate increased slightly until 1982, but an increase in adoption of family planning techniques has helped reduce the rate since then. Still, in the period 1988-93, only 14 per cent of married women in the child-bearing age in Pakistan used contraception, compared to 43 per cent in India and 40 per cent in Bangladesh during the same period.

Population Growth, Poverty and Human Development

Most of the increase in the global population over the past five decades has occurred in developing countries, and future increases are projected to occur in the poorest of them, mainly in South Asia (*World Development Indicators, 2000*). In 1999, five years after the Cairo conference, the United Nations recognised population as something more than just a demographic concept. It was considered a part of the development agenda, with governments and non-governmental organisations jointly implementing reproductive health programmes.

2.3 Livelihood

Economically, all South Asian countries are grouped under the category of 'developing nations'. The main source of income is, predominantly, from agriculture. As a general rule, greater the proportion of the Gross Domestic Product (GDP) in agriculture, more is the level of poverty. Bangladesh, Bhutan and Nepal fall in this extreme poverty category. Though Bhutan has a sizeable GDP derived from industry, these are from labour-intensive, non-manufacturing enterprises. India, Pakistan and Sri Lanka have almost a quarter of their GDP derived from industries, sizeable portions of which are from manufacturing.

A declining trend in the proportion of labour force in agriculture is a significant indicator of an increase in a country's manufacturing and service sectors, eventually fostering general development and accelerating population growth. In the 1970s, Bangladesh, Bhutan, Nepal, Pakistan, India and Sri Lanka showed declining proportions of labour force in agriculture. Today, Bhutan and Nepal still have the highest proportion of labour force in agriculture, followed by Bangladesh, which is indicative of their low rate of development.

A large female labour force is an indicator of a liberalisation trend in a malé-dominated society, while a low female labour participation results from the pressures of unemployment that force malé workers to grab whatever employment is available, thereby leaving females out of work. In the case of India, Bhutan and Nepal there had been a decline in female labour force participation between 1970 and 1992. Pakistan, Sri Lanka and Bangladesh show an increasing female labour participation.

Gross National Product (GNP) per capita is a simplistic, yet significant indicator of the economic level of a country. According to a 1998 report, Iran has the highest GNP per capita (US $1,650), Maldives GNP per capita (US $1,130) followed by Sri Lanka (US $810), Pakistan (US $470), Bhutan (US $470) and India (US $440). Bangladesh (US $350) and Nepal (US $210) had the lowest. Though per capita GNP has increased in all the countries of the region, the most remarkable increase has been in the Maldives and Sri Lanka.

Paradigm Shift

The urban population of all the eight countries of South Asia is growing both in numbers and as percentage of the total population. One of the most important push-and-pull factors for rapid urban growth is livelihood option. Pakistan continues to remain the most urbanised and Bhutan the least in the region. The Maldives had a low urbanisation rate in 1970, but urbanised very fast during the 1970s and 1980s - which can be attributed to the opening up of the country for international tourism, particularly aquatic recreation. The United Nations has projected that about 38 per cent of the population of both Pakistan and the Maldives will live in urban areas in 2000 and by 2005, this percentage in the Maldives will surpass that in Pakistan.

3.0 Political and Governance Structures

Democracy in South Asia is not about people, but about access to state power. This has led to a situation where the ultimate authority over resources is vested in individuals, rather than in formal institutions that have checks and balances. In such a state, power is highly personalised and the institutions of governance tend to be weak.

Even after independence from their colonial rulers, some of the countries in the region have faced feudalistic forces and a tendency for the oligarchical form of power. Countries such as Nepal and Bhutan are still following the traditional monarchical-dynastic governance structure, although Nepal has a democratically elected government under a titular head. India and Bangladesh have democratically elected governments. India is, in fact, the largest democracy in the world.

Political Structure and the Environment

The political structure of a country affects the environment of the region to a great extent. It has both positive and negative impacts. People's participation in the political process ensures that they are involved in decision-making and the judiciary. It provides the people with access to resources and the responsibility of ensuring their protection. Conversely, where there is no involvement of the people and the political structure is more of a dictatorship, the people will have limited or no rights over the resources of their land.

3.1 Governance Systems

The development of political and governance institutions in the region has been slow, largely owing to an informal society which depends on kinship and patronage. This disregard of institutions has made social and economic transitions unpredictable, thus leading to misgovernance even in democracies. The executive, comprising the cabinet and the civil service, is responsible to the parliament, but should also be accountable to the people. However, this accountability has become diluted over time. Also, the countries of the region are characterised by their huge bureaucracies, which breed inefficiency and corruption and impose heavy costs. The legislature, the second institution in governance in most South Asian countries, has been found wanting in its role: that of truly being the people's representative. Those elected to parliaments and state legislatures spend less time in making laws, policies and entering into constructive debates for the well being of their constituents, than in playing the game of political one-upmanship. Parliaments are generally ineffective as well. The committees overseeing various aspects of governance have neither the time nor the capability to indulge in fruitful discussions for resolving important issues. Lastly, the judiciary, which is supposed to be a watchdog and above partisan considerations, has also been affected by politicisation and corruption. Although the higher courts continue to enjoy public confidence, long delays and influence of the privileged continue unabated. Courts continue to be manned by insufficient number of inadequately trained and ill-paid judges, which adds to the delays and the huge backlogs of cases.

Good political governance comes from universal respect for the political process, from securing the sovereignty of citizens, ensuring their participation at all levels of decision-making and building institutions that protect the sanctity of established procedures. For good governance, it is essential to promote civic consciousness among the people and open democratic processes where demands can be articulated.

3.2 Policies for Regional Cooperation

The countries of South Asia had long felt the need for regional cooperation, and an idea finally took shape during 1977-80. The first meeting of the region's representatives was held in Dhaka in December 1985. This meeting adopted the charter of the South Asian Association for Regional Cooperation (SAARC). An Integrated Programme of Action (IPA) was evolved to cover subjects such as Agriculture, Communications, Education, Culture, Sports, Environment and Meteorology, Health and Population, Prevention of Drug Trafficking and Abuse, Rural Development, Science and Technology, Tourism, Transport, and Women and Development.

The region has been a hotbed of tensions because of several issues: water is one of them. With growing populations, water scarcity has become endemic. Today,

water can no longer be considered a completely free resource and plans must be made for its efficient use through better management, rules that preserve everybody's access to it. Since it is a common resource, its development and management should involve all beneficiaries.

The South Asian nations have seen numerous water-sharing disputes: between India and Pakistan over the tributaries of the Indus, between India and Bangladesh over the release of water of the Ganga through the Farakka Barrage, and between India and Nepal over the Gandak. With no formal agreements governing the issue, sporadic tensions over the release and sharing of water had been common. Recent years, however, have seen some softening of stands by the governments concerned.

The region also faces the problem of refugees crossing over from one country to another. In India, Bangladeshi refugees have kept up a constant stream of migrations to Assam, resulting in serious demographic changes. The Chakmas (the Buddhist minority in Bangladesh), who fled their homes in the Chittagong Hill Tracts, have moved into the north-eastern Indian states.

India and Nepal, because of a free border without any passport restrictions, have been confronted with large scale illegal trading and smuggling activities across the border. There seems to be no formal agreement to solve such problems.

South Asian countries have to go a long way in incorporating a model system of governance. The requirement is that of an enlightened democracy where the powers understand their obligation as true representatives of the people and not their masters, and in turn, the people realise their duties and responsibilities. To make their voices heard in the community of nations, the South Asian countries have to ensure cooperation in all aspects of governance.

4.0 The Economic Base

The South Asian region* is a key economic zone, seen from the global perspective. It assumes prime importance due to two fundamental reasons: firstly, its huge population makes it a lucrative market for all kinds of products and the fact that this region is growing fast, adds to this trend. Secondly, the countries of this region, with the exception of the Maldives and possibly Sri Lanka, are all major debtor countries and are unable to break free from the 'low-level equilibrium trap' - basically created by the low rates of capital formation - that compounds the need to secure resources from other sources to build up a capital base.

Following the East Asian meltdown, there has been a diversion of global funds towards this region and this, therefore, is a very crucial stage for the region as a whole. As the global economy tends to become smaller, international trade assumes far greater importance. Today's world market is a much more complicated arena, and developing countries are increasingly being marginalised by larger economic blocs such as the European Union. Political leaders have understood the need for co-operation at the regional level to ensure better terms of trade in the global marketplace.

All of the above means, that the region for its survival, has to perform at higher qualitative levels and yet manage to produce the quantities that would be able to feed its rapidly growing population. The nineties had seen India, Pakistan and Sri Lanka join the Maldives, Bangladesh, Nepal and to an extent Bhutan in liberalising and thereafter globalising their economies. The key reason behind opening the doors of the economy to outward competition was to ensure that competition would raise the quality levels domestically, and enable the country to fetch better prices in the global market.

This shift had another angle to it, which had more fundamental, longer term, implications. This was in terms of resource conservation. What constituted an improvement in corporate bottomlines through wider participation of actors globally is today being perceived as resource conservation - more value for the same amount of inputs (thanks to improved technologies), a move towards sustainable forms of development. The flip side was the destruction of good ecosystems such as forests to grow crops that had export potential.

A price to be paid in terms of natural resources, however, is not what the process of economic integration of a global nature is all about. The 'rate of output generation' has replaced production as the target indicator of sustainable growth patterns. This sustainability has assumed increasing importance globally. This region, mostly because of its rich natural endowments, has been getting increasing attention. That the environment today is more than just an issue for debate has been made very clear by the Seattle Round. It is for the South Asian region now to take cognizance of the rapidly changing scenario that governs international trade, and initiate collective action. With more than a fifth of the world's biodiversity under its belt, its rich abundance of mineral deposits, its potential as a huge market and its highly skilled pool of human capital, an unified South Asia can bring more than a bargaining chip to the global negotiating table.

4.1 Gross Domestic Product

The region has experienced fairly high rates of growth in the past decade. The annual per cent growth rate of the region has varied from 5.6 in 1990 to 4.6 in 1997 and 5.6 again in 1998. The projected growth rate of the region has been 4.8 for the period 1998-2001.

Table 1: Gross Domestic Product, South Asia*

Item	1990	1997	1998
GDP ($ millions)	4,10,341	5,53,211	5,65,131
GDP growth (annual %)	5.6	4.6	5.6

Source: World Bank
* does not reflect data of Iran.

4.2 The External Debt Situation

Table 2 reveals some very startling facts about South Asia. To begin with, the amount of external debt in total GNP is very high for the region. In countries such as Maldives, Sri Lanka, Nepal and Pakistan, one out of every two dollars that are in circulation has been borrowed. Such high levels of external debt have proved to be very counter-productive in the case of the Latin American nations and some of the East European states. A closer look at the figures reveals that Nepal and Maldives are in greater debt from multilateral sources. It has also been observed that all

Table 2: Amount of External Debt

Country	Ext. debt-1997 *(Million $ US)*	As % of GNP	Long term debt in total debt *(%)*	Composition *(%)*		
				M	B	P
Bangladesh	15,125	35	96	66	33	1
Bhutan	89	39	97	84	13	3
India	94,404	25	94	33	26	41
Maldives	160	52	96	65	25	10
Nepal	2,398	49	98	85	13	2
Pakistan	29,665	48	87	46	37	17
Sri Lanka	7,638	51	88	43	49	8

Source: Asian Development Bank

the countries that are heavy debtors, with the possible exception of Pakistan, depend strongly on tourism as an important source of revenue - with Maldives and Nepal leading the group. This implies that tourism has not been able to generate enough money for infrastructure development. Consequently, in spite of Maldives being the richest of the South Asian nations (its per capita income is over US $1,300), it has to depend on foreign sources for generating funds for its development. This aspect is borne out by the fact that most of the loans have been directed at building up socio-economic infrastructure incorporating environmental concerns, with some importance attached to the energy sector. As far as Nepal is concerned, the picture is almost identical: infrastructure development is a key component of the lending portfolio.

Secondly, the levels of long-term debt as a component of the total debt are extremely high for all the countries. While this is fast becoming a common phenomenon, and governments across the world have been known to favour long-term debt due to its low impact on the current deficit levels (debt-servicing is not usually a worry in the short term), the risk of the country going into a debt-trap seems to loom large. In a debt-trap situation, the country has to borrow just to ensure timely instalment payments of its loans, which leads to the subsequent borrowings yielding zero returns while not adding to developmental effort and depressing the situation further.

Thirdly, the low participation of private funds implies that in these countries, the financial markets have not developed as a viable alternative. With the exception of India, all the other countries have hardly 10 per cent of the total external debt coming from private sources. The advantage with private sources is that the risk is spread over a large number of players. Nepal, for example, with a 98 per cent dependence on long-term debts and with only a 2 per cent private share, presents a grim scenario. On the other hand, India appears to be comfortably placed with the bulk of the support coming from private sources, so that the risks arising out of borrowing from the multilateral and bilateral sources are largely minimised.

4.3 The Need of the Hour

How strong is our financial base? The answer may not be very encouraging. However, if we revert to the first table and analyse the same figures through the declining levels of dependence on external debts, the emerging picture appears to be a positive one. Net domestic savings have been very high, and investments have gone up over the decade. The economies having opened themselves up to competition, and the possibilities as of now are infinite. The need of the hour seems to be to utilise and encourage Foreign Direct Investments (FDIs) for building up the infrastructure, rather than depend upon multilateral assistance. FDIs, especially in the form of investor equity, contribute to national economic development in a debt-free manner. *Table 3* shows that the level of FDIs has increased dramatically over the last 15 years, and there is a lot of scope of further raising it.

Another way out, in addition to promoting FDIs, is for the respective governments of individual countries to try and reduce government spending. Every country in the region is facing rising fiscal deficits. In cases such as in India where deficit financing has been resorted to, the result has inevitably been inflation (double-digit inflation during 1987- 1991 was largely due to the Indian government resorting to deficit financing; the currency had to be ultimately devalued to stabilise the situation in 1991). Government funds in all the countries, with the possible exception of Maldives, have been targeted on three broad areas - infrastructure,

Table 3: Foreign Direct Investment ***(US$ million)***

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995
Bangladesh	3.2	1.8	0.2	3.0	1.0	4.0	14.0	11.0	2.0
India	212.0	91.0	252.0	162.0	74.0	277.0	550.4	973.3	2143.6
Maldives	5.1	1.2	4.4	6.0	7.0	7.0	7.0	9.0	7.0
Nepal	1.0	1.0	1.0	6.0	2.0	4.0	6.0	7.0	8.0
Pakistan	128.8	185.6	209.6	244.0	257.2	335.0	346.0	419.0	719.0
Sri Lanka	59.5	45.7	19.7	43.0	48.0	123.0	195.0	166.0	56.0

Source: Asian Development Bank

defence and social welfare. If investments in the first are to an extent desirable, the last two sectors have largely suffered from infructuous and misdirected spending. The solution lies in terms of selective budgetary spending for creation of capital, both physical and human, with perhaps more stress on the latter. Productivity of public spending (and not purely political considerations), both from the short- and the long-run perspectives, should govern investment decisions.

Since South Asia is the second fastest growing economic zone (after East Asia), economic growth has brought new problems with it, notable among which is the pressure it puts on the environment. Many areas of South Asia are already experiencing increasing pollution, soil erosion, land degradation, etc. The high population growth has cut deeply into the natural resource base. As the urban population in the South Asian countries grows, the urban environment deteriorates rapidly. Progress in preventing long-term damage will require much more aggressive policies and monitoring than in the past.

One can give numerous examples in the developed economies where a passive government has been able to engender higher growth rates with lower external indebtedness, and much lower incidences of corruption. As arguably one of the most vulnerable economic zones from this perspective, governments in South Asian countries need to re-assess their roles, more as watchdogs than as harbingers of fundamental improvements in the country's economic standards. The environment of South Asia is threatened as never before; its carrying capacity is under tremendous pressure. At this stage, the policymakers, having opened the doors for technological leapfrogging, foreign capital inflows and competition from all over the globe, should limit their role as providers of basic infrastructure and an enabling environment for business to be conducted without fear of life and property loss.

PART II

Key Environmental Concerns

Economic development and environmental quality were always thought of as independent entities; we now find them closely linked. In fact, the concept of sustainable development carries with it the premise that economic, environmental and social well-beings are interrelated. It highlights the need to use the resources and services of the environment to improve the quality of people's lives in a manner that does not diminish or compromise the environment's capacity to provide for future generations.

In the South Asian region, this capacity stands severely endangered as of now. Some of the key environmental concerns of the region that have been discussed here are aspects of livelihood security (i.e. food, water, energy and income), impact of environmental disasters, industrial pollution, urbanisation and the biodiversity. These concerns have been classified on the basis of an inventory of issues followed by prioritisation.

1.0 Livelihood Security

The concept of livelihood is an essential means of understanding the factors that influence people's lives and well-being, particularly in the South Asian countries. The concept is based on the dynamics of the means through which people secure a 'living' - that is, the goods and services that allow them to survive. These include food, water, energy and income, all of which have been covered in this chapter on livelihood security.

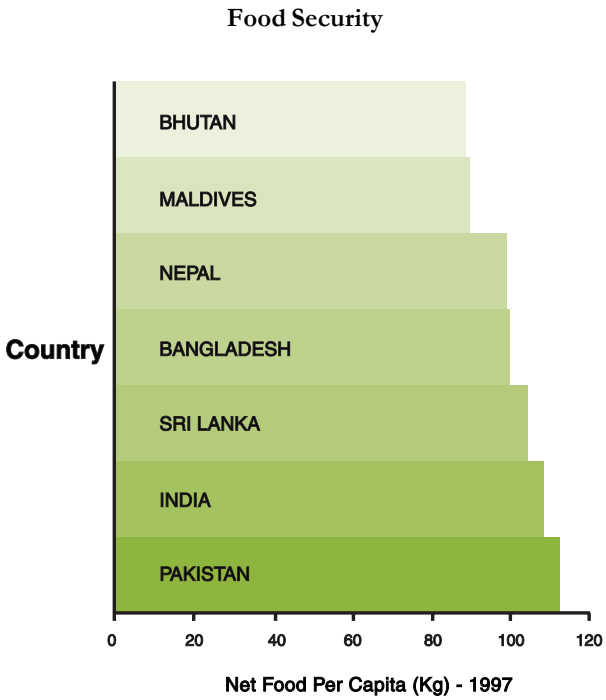
Food security, which is of prime importance, is not a result of one single factor, but a consequence of the combined effect of many factors that have been elaborated in the pages that follow. Water is one of the most precious of resources which, due to growing population and diversifying needs, is fast becoming scarce. Energy is a crucial determinant of development. The hand-glove relationship between energy use and economic development means that developing countries will find an access to energy to be a key ingredient of their future economic and environmental development. Lastly, income security is another important indicator of economic development.

1.1 Food Security

State of Food Security

The proportion of undernourished population in the region doubled from 6.0 per cent in 1995-97 to 12 per cent in 1999, resulting in an accompanying increase in infant mortality and the number of anaemic mothers. Employment and income losses, savings and capital flight well into 1999, as well as civil unrest have meant that chronic food insecurity will increase in the foreseeable future. The recovery will take time, as suggested by the Gross Development Product (GDP) growth rate forecasts of 2 and 4 per cent for 1998 and 1999 respectively, after a contraction of 13.2 per cent in 1997[1]. While a fall in rice production has affected food security, reduced household expenditures on and thus lower consumption of protein and micronutrient-rich foods have also contributed to the overall deterioration in the situation.

The 1990s saw the emergence of man-made calamities that exposed populations to the problem of severe food scarcity. In this category fell war, civil strife, financial and economic mismanagement, environmental destruction (FAO, 2000) and unemployment in the rural labour market created due to shrinking carrying capacity of the land. These man-made disasters created some vulnerable groups in society, such as permanent refugees (the Tibetans in India, for instance), internally displaced people (the Tamils in Sri Lanka, Kashmiris in India and the Muhajirs in Pakistan), widows and orphans borne of religious and ethnic fighting, migrant workers and their families, etc.



Data not available for Iran
Source : FAO, 2000

[1] Twenty-Fifth FAO Regional Conference for Asia and the Pacific, 2000

Issues in Food Security

- Low productivity as a result of land degradation and water scarcity
- The lack of preparedness to deal with acute and large-scale food shortages due to natural disasters
- Risks associated with rising dependence on food imports
- Inefficient marketing systems
- Limited access to food owing to poverty
- Pervasive malnutrition, sanitation and health-related problems

Population growth and demographic implications: The breakdown of agriculture as an industry has been accompanied by a population growth - giving rise to problems of urban infrastructure, air and water pollution and their health implications. These problems have assumed bigger proportions due to out-migration to cities in the search of food. Today, in India, the urban population exceeds the total population of USA. The National Commission on Urbanisation[2], in its report, has clearly stated that urbanisation must be an input to agricultural development. A demographic challenge in the form of increasing numbers (every minute, 48 children are born in India) will threaten basic natural resources, including land, water and environment, and generate newer types of socio-political demands.

The results of this trend are already apparent. The population of children in the region has reduced tremendously at the cost of the increasing numbers in the reproductive age groups and the elderly. The greatest impact as far as health issues are concerned will be for the elderly population: the momentum is expected to double the elderly population's numbers. So, the emphasis of the health care delivery services in the next half-century should be on child care and the expansion of services for the elderly and women.

Food production, net exports and self-sufficiency ratios:
Hunger is the worst form of malnutrition. According to the FAO, 790 million people - roughly one out of five in the developing world - are chronically hungry (State of the World 2000). This figure is likely to underestimate the number of the hungry because it is based on calculations of calories per person in developing countries - a method that does not account for the unequal distribution of food found virtually everywhere. The FAO estimates that 21 per cent of India's population is chronically undernourished. Some 44 per cent of South Asian children are underweight, with those in India and Bangladesh well above this average[3]. Forty-nine per cent of adults, and 53 per cent of children (of the age group 1-4) and pregnant women in India, and 56 per cent of the same in Bangladesh, are underweight (Measham and Chatterjee, 1999). Based on the share of children who are underweight, hunger in the developing world has been estimated to have fallen by 10 per cent over the past two decades: 26 million fewer children are estimated to be underweight in 2000 than in 1980.

To what extent does the region have to meet its food requirements by importing what it cannot produce itself? Conversely, by how much do some countries have to produce more than they need in order to export? The self-sufficiency ratio (SSR) holds the answer, as it links the key components of food demand

Table 1: Agri Population - Estimated and Projected

Population estimated & projected agri pop. (per 1000)	Year						
	1950	1960	1970	1980	1990	2000	2010
Bangladesh	37,436	45,069	55,671	64,047	71,460	71,990	69,650
Bhutan	699	825	1,003	1,245	1,597	1,991	2,572
Sri Lanka	4,517	5,672	7,015	7,805	8,402	8,721	9,021
India	2,65,620	3,07,188	3,72,514	4,44,316	5,06,548	5,57,432	5,78,351
Maldives	65	74	86	89	82	78	69
Nepal	7,486	8,799	10,694	13,596	17,580	22,276	27,479
Pakistan	29,714	34,521	44,643	56,827	66,220	79,424	91,083

Source: FAO,2000

[2] National Commission on Urbanisation, 1988v
[3] 'Nourishing the Underfed and the Overfed', *State of the World 2000*

Table 2: Crops (net per capita)

Crops Net	Year									
Per-Cap (PIN)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Bangladesh	99.2	100.3	99.6	97.0	91.5	92.4	95.9	95.4	94.7	96.3
Bhutan	100.7	101.4	102.5	103.1	103.8	103.2	100.7	98.0	95.1	92.4
India	99.0	98.6	100.6	100.9	102.8	103.6	104.5	105.0	102.3	104.9
Maldives	104.7	100.0	100.7	100.2	98.7	98.6	95.1	95.0	92.2	89.9
Nepal	102.3	96.7	88.0	99.4	90.4	97.7	99.2	97.5	96.6	96.9
Pakistan	97.5	105.6	93.4	93.4	92.3	102.0	98.0	94.0	97.0	92.7
Sri Lanka	104.5	99.0	91.8	99.1	105.1	108.5	97.8	100.7	103.4	102.4

Source: FAO,2000

and food production through trade.

In 1989, despite the large deficit of the Middle East and the large net exports of Latin America, by 2050 the SSR for the former region will fall from 57 per cent to 36 per cent, while South and South-east Asia will move from a net surplus in 1989 (SSR = 1.08) to a substantial deficit in 2050 (SSR = 0.88). As far as animal products are concerned, there is relatively little change in the self-sufficiency ratios.

Rising Demand for Food and its Impact

Two centuries ago, an English vicar had expressed concern over the growth of human numbers and its effects on the finite natural resources. Thomas Malthus (1798) thought "the power in the earth to produce for man" was already falling behind the growth in population, and that "the period when the number of men surpass their means of subsistence has long since arrived". Some 50 years later, Karl Marx, attacking Malthus for blaming famine on natural laws rather than social forces, enlarged the scope of the debate: he said that famine was not a failure of supply, but of demand. The causes were lack of purchasing power leading to poverty. The continued unfavourable conditions that prevailed in the market discouraged the dominant small holders from adopting short-term yield-enhancing measures.

In South Asian countries, foodgrain production has increased three-fold over the last four decades, but this progress has been largely offset by population growth. Thus, over the years, per capita net availability of cereals has, in fact, declined. A large segment of the population continues to face chronic and persistent food insecurity. About 40 per cent (360 million) of the population in India belongs to the food insecure category, and consumes less than 80 per cent of the minimum energy requirements (*WFP, 1997*). Sixty-two per cent of the tribal groups and 54 per cent of the schedule caste groups live below the poverty line (*UNDP Human Development Report 2000*). While the absolute number of the hungry is expected to remain high in the future, there could be about 580 million people suffering from chronic undernourishment (*FAO, 2000*).

Cropping Intensity

Poverty and Hunger in India: A Production Success Story but a Consumption Disaster

In India, wheat harvests more than doubled under the impact of the Green Revolution between 1965 and 1972 - this was the most spectacular increase in its agricultural history. It provided food to the newly emergent Bangladesh and for a while, became the world's second biggest donor after the United States. By the mid-1980s, the country had a grain surplus of 24 billion metric tonnes. But it still had about half of all the hungry people on earth. Consumption of grain per head has failed to increase over the period of the production 'miracle', and nearly half its people are too poor to buy. A study on malnourished Indian children under five for the next 17 years of their lives found that their capacity for work was 30 per cent less than that of children from the same class and the same villages who had enough to eat.

A classic response to land shortage and/or high prices has always been to intensify its use by shortening fallow periods, or - if the availability of water permits - squeezing two or more crop production cycles instead of one on a given parcel of land each year. In most of South Asia, the monsoon rains are adequate for growing two crop cycles a year. In some places, because of good moisture-holding capacity of the soil, a third relatively drought-resistant crop can be grown (*Hoque, 1984*).

Table 3: Food Availability (net per capita)

Food Net Per - Cap (PIN)	Year									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Bangladesh	99.6	100.3	100.1	98.6	93.6	95.7	99.7	99.4	97.9	99.9
Bhutan	101.1	99.7	97.8	97.6	99.3	98.3	96.0	93.4	90.6	88.0
India	99.6	99.4	101.4	102.5	104.3	105.3	106.2	107.5	104.7	107.8
Maldives	104.3	99.9	100.4	100.0	98.4	98.2	94.7	94.6	91.8	89.5
Nepal	102.0	97.8	91.0	98.8	93.0	98.2	99.0	98.7	98.3	98.0
Pakistan	99.5	100.9	100.5	104.4	105.4	111.2	112.1	111.6	116.1	111.9
Sri Lanka	104.6	98.4	99.3	102.0	109.6	113.2	98.7	100.9	104.7	103.6

Source: FAO,2000

Cropping Intensity in Punjab, India

Cropping intensity in Punjab was 1.18 per cent per hectare in 1951. In other words, in a calendar year, the farmer could produce only 1.18 crops from a unit area, and for long periods the field remained fallow or uncultivated. On the contrary, in 1998, the cropping intensity reached 1.9, which indicates that for almost 300 days in a year there was crop-related activity. Neither the farmer nor the land was given rest, and this may have given rise to an unsustainable production system

(*S. Nagarajan, 2000*).

A case in point is that of Bangladesh. During the last two decades in Bangladesh, cropping intensities have increased by 15 per cent, aggregate fertiliser use by 600 per cent, proportion of irrigated land by 800 per cent, population of high yielding varieties by 1,300 per cent and the rate of rice yield by 65 per cent (*Table 4*).

As the rate of agricultural growth slows down, environmental pressures will grow, but at a lower pace than in the past. For example, the rate of deforestation is expected to diminish reflecting the slowdown in the expansion of arable land. The increase in the use of fertilisers, pesticides and other agricultural inputs will also slow down. However, a growing livestock population could have increasing adverse environmental effects by augmenting land, water and air pollution (*FAO, 2000*).

Changing Food Consumption Patterns

Foodgrain production in South Asia is affected primarily by the way its inhabitants adjust to the environment. Rice, which constitutes 41 per cent of India's food production, is grown wherever the physical conditions are favourable (*Atlas of South Asia, 1998*). Although rice or wheat form the staple diet of the area, the food and related cultural habits and consumption patterns of the population have been adjusted in accordance with the traditional food growing customs of the area. For example, the north-eastern part of India is wheat-eating, while the eastern and southern parts prefer rice.

Table 4: Increasing Intensity of Bangladesh Agriculture

Year	Cropping intensity irrigation	Proportion of net sown area under HYV[4]	Proportion of rice and wheat under *(million ton)*	Total use of chemical fertilisers *(lb per acre)*	Yield of rice crops
1969-70	1.51	3.8	2.76	0.28	1003
1972-73	1.42	12.3	11.1	0.38	953
1976-77	1.48	16.9	14.2	0.51	1102
1980-81	1.54	18.6	18.6	0.74	1119
1984-85	1.54	19.7	19.7	1.43	1227
1988-89	1.68	32.9	32.9	1.69	1354
1990-91	1.72	35.5	35.5	2.04	1544

Source: B.B.S. Statistical Year book,

[4] High Yield Variety

Assessment for the region points out that dietary standards and patterns are adjusting gradually with rising incomes and as average yields continue to improve. There is also a progressive expansion of agricultural and settlement areas at the expense of forests and other land. These trends ease off towards 2050 as the growth of population and per capita food consumption slows down (*'Global land and food in the 21st century', Trends and Issues for Sustainability, Gerald Leach, 1995*). Cultivated land may be lost for several reasons. It can be converted to other uses which are judged to have a higher value such as houses, factories, roads, etc. The cultivated land area may change due to less productive form of agriculture or due to physical degradation and marginalisation - the land is no longer worth working under existing economic conditions. The quality or innate productive capacity of the cultivated land in use will also change due to human induced land degradation.

During the last three decades, human food consumption measured as dietary calories has almost doubled. While the population grew by 69 per cent from 1961 to 1989, an average person's intake of calories rose by 20 per cent. These changes were even greater due to changes in the lifestyles of the people - breaking down of joint families into nuclear units, switch-over from traditional food habits to fast foods, and increasing consciousness of physical appearances.

Role of Market Forces

The agriculture industry today is mainly driven by the existing market forces, which in turn hold fast to the changing food consumption patterns. The farming community is dependent on the subsistence of their produce from limited natural resources. Market forces have shifted the cultivator's focus from the traditional sustainable cropping system to a more market driven one - the cultivation of cash crops. The growth of cash crops tends to take up the best land, pushing subsistence farmers onto areas with poorer soil and driving unsustainable use of fertilisers, pesticides[5], and agricultural devices.

Inability of Systems to Fulfil Demand

Agriculture is vital for food security, because it is the major source of food and is the primary means of employment and livelihood for the vast majority of poor households. Unfortunately, though agricultural production has continued to rise, rate of yield per hectare has started to decline. At the time when the Green Revolution was adopted, sustainability was not the criteria. Wheat and rice were the king crops. But these were not the traditional varieties; they were water thirsty, chemical-intensive hybrid crops.

Table 5: Cropping Intensities of the Year 1989, 2025, 2050 Relative to 1989

Region	1989 actual			2025 relative to 1989			2050 relative to 1989		
	Rainfed	Irrig.	All	Rainfed	Irrig.	All	Rainfed	Irrig.	All
South Asia	0.95	1.20	1.02	1.10	1.07	1.09	1.20	1.15	1.18

Source: Leach,G. Global land and Food in the 21st Century, Stockholm Environment Institute, 1995.

Table 6: Total Fertilisers Consumption (Mt)

Region	1992	1993	1994	1995	1996	1997	1998
Bangladesh	998,744	948,882	1,049,347	1,194,097	1,188,450	1,107,933	1,171,000
Bhutan	100	100	100	100	100	100	100
India	12,217,800	12,395,000	13,563,600	13,876,100	14,321,744	16,188,00	16,797,500
Nepal	82,886	74,021	90,981	93,699	103,000	108,900	121,300
Pakistan	2,147,922	2,146,722	2,183,572	2,507,669	2,412,905	2,659,334	2,461,254
Sri Lanka	183,657	210,091	213,045	199,861	211,389	210,826	233,128

Source: FAO,2000

[5] In the early 1980s, one-fifth of all US pesticide exports had been banned at home. Ironically, the banned pesticides often return to home country consumer as residues in imported foods. The cost of production has also risen. In Bangladesh during the last 10 years, the production cost for rice has increased by 250 per cent.

Nepal: A Disaster in the Making

Three decades ago, a farmer in Nepal used only 494 tonnes of chemical fertilisers annually. This has jumped to more than 50,000 metric tonnes per year today. Soil fertility has dwindled fast due to overuse of chemical fertilisers and continued use of unscientific agricultural systems. The area for principal cash crops (sugarcane, oilseed, tobacco, potato and jute) increased by 140,000 ha with over four-fold production (670 to 2,782 thousand mt) during the period 1974-75 and 1998-99 (*SOE Nepal , June 2000*).

In just over three decades, Nepal has turned from a small-time exporter of foodgrain into a net importer, with pests devastating large areas of paddy in the Terai, the country's 'food bowl', despite the dramatic increase in use of pesticides in this period. "Nepal is probably headed for mass starvation in a decade time if the Brown Plant Hoppers (BPH) menace is left uncontrolled," warns entomologist Shreebaba Pradhan at the government's National Agricultural Research Council (NARC). Pesticide misuse decimates the natural predators of pests such as spiders, crabs, beetles and dragonflies, he says, adding that "due to this imbalance in the food-chain, pests have increased dramatically this year". The Department of Agriculture estimates that BPH wiped out paddy spread over 25,000 hecatres of arable land in the Terai.

A Tragedy in India

Farmers in Karnataka and Andhra Pradesh in India committed suicide because their crops failed due to pest attacks. They had pawned even the jewellery of the women to buy pesticides which proved ineffective. Rather than face the shameful prospect of not being able to retrieve the jewellery, they preferred to die along with their families, including children. Could there be a bigger tragedy in the global history of pesticide-induced disasters?

Unsustainable Practices and their Effect on Natural Resources

Agricultural practices:

In terms of their direct impact on the environment, farming activities are the major contributors to soil erosion, salinisation and loss of nutrients. It has been estimated that about a quarter of the soil degradation in Asia has occurred directly from agricultural activities. In addition, natural habitats are being destroyed, degraded and depleted and countless numbers of wild species are being lost in pursuit of food production.

Intensive cultivation of land without conserving soil fertility and soil structure has led to the springing up of deserts. Irrigation without arrangements for proper drainage has resulted in soil getting alkaline or saline. Indiscriminate use of pesticides has caused adverse changes in biological balance and is leading to an increase in cancer and other diseases. Unscientific tapping of water has depleted ground water reserves. While some regions are turning into deserts, others are suffering from severe waterlogging. Indiscriminate use of chemicals and intensive cropping have robbed the soil of its nutrients, poisoned the ground water and contaminated crops.

Soil salinisation:

Agricultural land has become unproductive due to dryland salinity. In Bangladesh, an area of 1.3 million hectares is affected by soil salinity. In India, 9.38 million hectares are salt-affected soils (*Government of India, 1990*), and in Pakistan this figure is 10-12 million hectares. In fact, in Pakistan, the average yields of wheat, rice, cotton and sugarcane decreased by about 50 per cent in slightly saline soils and by 75 per cent in moderately saline ones. In Sri Lanka, saline soils occur mainly in the tidal flats, estuaries and deltaic deposits. With the introduction of irrigation, soil salinity has increased in inland valleys; 0.7 million hectares are now salt-affected.

Table 7: Projected Production and Consumption of Natural Resource in India

Year	Consumption	Production	Deficit
		(*thousand tonnes*)	
2000-01	669	649	20
2005-06	929	757	172
2010-11	1232	848	384

Source : K J Mathew. Focus on cost efficiency, The Hindu Survey of Indian Agriculture, 2000

Land degradation:

The increased density of farming tends to reduce farming efficiency and hence, the overall productivity of the land. In Bangladesh and India, this problem has been compounded by land fragmentation, which has further reduced the average size of land holdings.

The option of expanding grain production at a global level by cultivating more land has virtually disappeared. Heavy cropland losses during next half century are expected in India, where the construction of housing alone will occupy a substantial area. The main causes of land degradation are thought to be agricultural activities, deforestation and over-grazing. Estimates by the Government of India (1990) suggest that 53 per cent of total land area in the country has already been degraded.

Table 8 : Land use - Arable Land

Land Use - arable land (*1000 ha*)	1981	1991	1992	1993	1994	1995	1996	1997	1998
Bangladesh	8,896	8,837	8,018	7,919	7,804	7,823	7,860	7,901	7,992
Bhutan	105	113	115	115	120	130	135	140	140
India	1,62,891	1,62,740	1,62,370	1,62,637	1,62,490	1,62,250	161,830	1,61,600	1,61,500
Maldives	1	1	1	1	1	1	1	1	1
Nepal	2,287	2,287	2,350	2,500	1,700	2,898	2,898	2,898	2,898
Pakistan	19,996	20,500	20,600	20,860	20,960	20,984	21,080	21,440	21,425
Sri Lanka	840	878	885	860	863	866	867	868	869

Source : FAO, 2000

But though there has been massive soil degradation, agricultural yields have steadily increased due to the use of improved high yielding crop varieties, better irrigation systems and increased agro-chemical inputs.

Inadequate Infrastructure

Food storage and distribution system:

Strengthening food control services requires considerable development in infrastructure. Gains can be obtained through better processing and improved storage and distribution facilities. Improved food storage may also reduce vulnerability to famines and food shortages[6]. Although the region produces enough food, it is the storage and transportation aspects that need improvement. Since food production is concentrated during two seasons - *rabi* and *kharif* - the food needs to be properly stored for the rest of the year to prevent it from decaying or eaten by rodents. According to the FAO (*The Importance of Food Quality and Safety for Developing Countries, 1999*), lack of infrastructure for post-harvest handling, processing and storage leads to severe diminishing of quality and avoidable contamination and food losses.

Capacities of the system have to be built up periodically, and this needs resources. Assistance may be sought from international agencies such as the FAO, WHO, World Bank and others for this purpose. However, this will depend upon the priority that national authorities give to food control (*FAO, 2000*)[7].

The Finite Victims: Land and Soil

The region witnesses severe soil erosion at many places, such as throughout the Himalayas. In Sri Lanka, major contributing factors to soil erosion are deforestation on the steep slopes of the watersheds; shifting cultivation; removal of grass and other protective cover; and gem mining in the upland areas (*SAARC, 1992*).

Soil erosion results in a net removal of nutrients from the remaining soil. The continued use of inorganic fertilisers in most countries is causing marked deficiencies of many major, secondary and micro-nutrients in the soil. In a number of cases, imbalance in the use of fertilisers dominated by nitrogen has caused multiple nutrient deficiencies. For example, in Bangladesh, more than 50 per cent of the total agricultural area has suffered from a decline in soil fertility. Approximately four million hectares of cultivated land is estimated to suffer from sulphur deficiency and 1.75 million hectares from zinc deficiency. Sulphur and zinc deficiencies are widespread in rice fields.

In Nepal, over-exploitation of land resources and accelerated soil erosion have led to a major loss of plant nutrients and organic matter, particularly in the hilly areas which are characterised by steep slopes, high rainfall intensity and shifting cultivation. The mountain soils suffer from deficiency of calcium, phosphorous and other elements. In Pakistan, practically all soils are low in organic matter (less than 1 per cent) and nitrogen content, and about 80 to 90 per cent of agricultural soils have low to medium availability of phosphorous. In India, the average loss of plant nutrients from eroded soils is estimated to account for a loss of 30 to 50 million tonnes of agricultural production.

Soil erosion due to wind is widespread in the arid and semi-arid regions. This is primarily true of the desert regions of Pakistan and India. In India, the estimated area affected by wind varies from 17 to 39 million hectares. The problem in India is aggravated by the increased use of tractors for ploughing cultivated fields. The soil loss under different site conditions has varied from 407 tonnes/hectare in fallow land to 932 tonnes/hectare in ploughed land (using country ploughs) and

[6] India recently exported grains from its reserve stock mainly due to lack of proper infrastructure to store the grain, and because of the very high cost burden on the government for warehouses.

[7] FAO, Twenty-fifth Session: *The Importance of Food Quality and Safety for Developing Countries*

2,837 tonnes/hectare in disc-ploughed land (using tractors). In Pakistan, an area of about 4.8 million hectares is affected by wind erosion, out of which roughly one-third is severely eroded.

Desertification has resulted in an incalculable loss in land productivity and agricultural output. India's livestock population is about 450 million (roughly 13 per cent of world total), whereas the rangelands and pastures account for only 0.5 per cent of the world total. The excessive grazing is steadily degrading the rangeland and leading to desertification.

Natural Disasters and their Impact on Food Security

In recent years, the region has become one of the worst hit in terms of natural disasters. The size of the region, encompassing all types of climates and terrains, has also meant virtually all kinds of natural disasters - ranging from floods to droughts, cold waves, cyclones, earthquakes, forest fires, etc. Disasters mean two things: firstly, loss of life and thus loss of earning hands, leaving the dependents on the mercy of others. Secondly, loss of the already stressed resources, such as crops, soil fertility, etc. Since population density is high, disasters mean more of poverty and serious implications for natural resources and environmental conditions.

Earthquakes:

Seismic activity is fairly widespread in this region. Between 50-60 per cent of India and Nepal's entire territory are vulnerable to seismic activities of varying intensities. The September 1999 earthquake in Maharashtra, India, killed 12,000 and left many more homeless. The earthquake in Kutch in Gujarat in the year 2000 was even more disastrous. The whole of Nepal lies in a high seismic activity zone. Earthquakes in Nepal often result in landslides from unstable slopes, which have been deforested and degraded by human activity.

Landslides:

Landslides are aggravated by human activities such as deforestation, cultivation and construction, which destabilise the already fragile slopes. For instance, as a result of combined actions of natural and man-made factors, as many as 12,000 landslides occur in Nepal every year. Other mountainous areas such as northern India and Pakistan are also extremely vulnerable to landslides because of their rugged terrains. Avalanches and snowstorms particularly affect animal husbandry, the major source of food in the mountainous regions.

Floods:

Bangladesh, home of the largest river delta in the world, is used to dealing with regular floods. On an average, 20-30 per cent of the land gets flooded every year. Not all floods are disastrous. The annual floods in Bangladesh deposit alluvial in the delta and assure the land's fertility, making it possible to grow three crops a year. The soil in Bangladesh is one of the most fertile in the world. Problems occur when floods are much greater than usual, or happen with little or no warning.

Floods in Bangladesh in 1998 displaced as many as 25 per cent of the people, while at least 20 per cent faced malnutrition and illness. People starved for two-three days at a stretch. Loss of livelihoods was an acute crisis as demand for labour plummeted with vast parts of towns and cities going under water. People were forced to borrow money from money-lenders at steep interest rates. The post-flooding harvest of rice per acre was ¼ the average harvest, resulting in an official shortfall of 4.3 million tonnes of food for the year. Many animals died during the floods, hindering the subsequent work on land.

Deforestation in the Himalayas has led to increased sedimentation of the rivers in Bangladesh. Nepal has lost half its forests since 1953. Every year, the rains strip between 35 and 75 metric tonnes of soil from every hectare of the hillsides. This coats the river beds, raising them by 15 cm a year, causing floods during rains. It is said that in the past, when the Himalayas were covered with trees, floods hit Bangladesh only once about every half a century; by the 1970s, they were happening every four years or so. In India, annual flood losses are more than 14 times what they were in 1950s. In a typical year, 46,000 Indian villages get flooded during the monsoons, affecting nearly nine million hectares of land and inundating crops worth roughly US $60 million. In India, a total of about 40 million hectares are at risk from floods every year, with average annual direct damage estimated at US $240 million to US $1.5 billion.

Cyclones:

In the Bay of Bengal, cyclones cause very heavy rainfall and severe flooding and are often accompanied by devastating tidal surges. Bangladesh has been partcularly affected by this; India too suffers every year. The 1998 cyclone at Kandla Port and the October 1999 super-cyclone in Orissa, India, left two million homeless and marooned, 10,000 dead, 800,000 hectares of standing rice crops destroyed, and soil severely affected due to it being covered with salt water.

Drought:

The past few years have witnessed uneven distribution of rain causing floods in certain areas and droughts in some. Traditionally, marginal farmers have the least capital resources, little or no access to credit and produce no marketable surplus. Furthermore, since much of what they produce is consumed, any carry-over stocks are minimal. In conditions of drought, they suffer considerable hardships.

In India, about 33 per cent of the arable area - which is about 14 per cent of the total land area of the country - is considered drought-prone. Further, 35 per cent can also be affected by drought when rainfall is exceptionally low for extended periods. The number of people at risk has been estimated to be 185 million. The 1999 drought in India affected 130 million people - 15 per cent of the population - and more than 70,000 villages and 230 urban centres were at risk.

Pakistan also faced severe drought the same year with nearly three million people, mostly villagers, risking starvation. It devastated crops and livestock in the southern Thar desert, forcing thousands to flee the region. Between 1985 and 1987, millions of hectares of crops were damaged, affecting livelihoods of tens of millions of people and causing an estimated loss of income of US $2.4 billion. In Sri Lanka, the government provided relief to over two million people - about 14 per cent of the total population - during the 1985 drought. Nepal has also been subjected to severe droughts in the past. In 1981-82, crops were severely damaged resulting in a 1.4 per cent decline in GDP.

Food Aid - A Solution?

Food aid has helped in reducing poverty and the environmental dependence of the community. However, the effective use of food aid depends more on a recipient country's distinctive characteristics, its policies, priorities, resources and capacity. It is important to identify priorities that are needed for sustainable growth. These priorities may be designed at three levels - South Asian, country and regional. In all the seven countries of the region, there are a few common factors. One of them is the urgent need to improve rural infrastructures to enable community participation and a high rural alternate employment growth process for helping food insecure people achieve self-reliance.

The guidelines and criteria for food aid approved by the Committee on Food Aid (CFA) policies and programme in May 1979, is dependent on the financial, technical and managerial capacities of governments. There should be full commitment on the issue of sustainability - rather than seeing it as just an aid programme - from the community. A specific provision for self-maintenance and capacity-building should be the focus of an aid project from its inception.

Governments have launched several programmes to address the problem of food shortage of the poor. Among these, in India, are employment generating programmes implemented in drought-prone areas. For the people below poverty line, there is a provision of food at subsidised prices through the Public Distribution System and, in predominantly tribal areas, the Revamped Public Distribution System. However, these systems do not function adequately in remote areas, mainly due to lack of proper infrastructure and also because they depend on private dealers, who often find no incentive to extend their distribution activities to these far-off areas.

At the FAO's tenth session in April 1985, the FAO Committee on World Food Security considered ways to improve the contribution of food aid towards maintaining food security. The committee agreed on the measures to be taken, especially to improve the delivery of supplies in emergencies, and on using food aid for development. Between a fifth and a quarter of all food aid is channelled through the UN/FAO World Food Programme (WFP). With over 20 years of experience in food aid projects, WFP can ensure that needed food supplies are delivered rapidly in a way that does not discourage local agricultural production (*World Food Report, 1986*).

The root cause of food insecurity in the region is not the availability, but accessibility and affordability. To improve food security in a sustainable and self-reliant way, initiatives to improve and strengthen alternative sources of income and the resource base of the communities are the pre-eminent requirements.

Responses

At the Regional Level

The strategy for South Asia should be to increase sustainable food production and do more in terms of better research, information, infrastructure and incentives within a broadly favourable and stable macro-economic environment.

- The farmers should secure economic and social rights to the land they manage. It will boost innumerable local high skill methods, which in many cases will in turn maintain soil qualities and double or triple crop yields with little or no use of external inputs.

- In many countries, due to high population densities, sustainable agricultural development is no longer sufficient (*Lele and Stone, 1989*). Sustainable agricultural practices and income growth must be backed by a large array of public policies at the grassroot level for poor farmers. The root cause of the problem is that poor farmers who lack access to productive resources, are more likely to produce little and degrade land than the better endowed (*Blaikie and Brookfield, 1987; Pinstrup-Andersen, 1993; and English, 1993*). They will produce more if they are paid enough by the markets they can reach (*Sen, 1994*).
- At the international level, global trade barriers and policies have cut the prices of many crops which are critical to the economies of developing countries and their farmers ('*Global land and food in the 21st Century', Trends and Issues for Sustainability, Gerald Leach, 1995*). Radical reforms and a uniform policy for South Asia on food pricing and trading is required to enable the large increases in production that are needed. The short-term market signals have to be over-ruled by longer term socio-economic and political considerations.
- The widespread neglect of rural infrastructure undermines the entire agricultural enterprise: it reduces farm profitability, increases farmers' risks and prevents significant productivity. Poor roads, weak market structures and lack of proper credit facilities have greatly increased the costs of farm inputs such as fertilisers and reduced farm output prices, severely blunting incentive farming (*Cleaver, 1993*). At the same time, the existing social structures - inequitable land ownership and tenure systems - have discouraged sustainable land use practices. The UN system has been encouraging the approach of Technical Cooperation among Developing Countries (TCDC). Control of food production and distribution can benefit from this approach, particularly in manpower development and capacity building; this needs to be encouraged.

At the Local Level

Every country should have programmes seeking full access to food and food security for all groups within a community. There is a wide range of activities that local food systems have undertaken in pursuit of the above goals.

- Subsidies on fertilisers and pesticides encourage farmers to overuse/misuse them, creating serious environmental impacts. Farmers need to be educated about the benefits of organic farming along with integrated soil-healthy systems involving the use of green manure, biofertilisers, composting and minimum essential fertilisers. Multicropping should also be encouraged.
- Integrated pest management should be practised.
- Restaurants, schools, colleges and hospitals should be encouraged to buy from local growers and processors. Programmes need to identify and promote their produce and its sustainability.
- Farmers' markets restrict sales of the produce and the crafts within a fixed radius (50 miles). In India, the *haat* or *mandi* exists, but it has to be structured within the framework of policy.
- Encourage micro-food enterprises, such as local food processing units that try to incorporate more of the safety and nutrition aspects of street food.

A Change in Mindset Needed

We can make progress if we change our mindset from a commodity-centred approach to a cropping or farming system approach based on an integrated natural resources management strategy. In other words, research should be tailored towards enhancing the performance and productivity of diverse agro-ecological systems. An example is the prospect of 'super rice', capable of yielding over 10 tonnes of rice per hectare. Such a rice plant will need a minimum of 200 kg of nitrogen per hectare, together with other major and micro-nutrients. Addition of such nutrients solely through mineral fertilisers will lead to serious environmental problems.

(*Swaminathan, 2000*)

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1.2 Water Security

Introduction

Water is one of the most precious and vital resources for development and everyday living. Our growing population and rapidly diversifying and expanding needs make water an increasingly scarce resource. This is a challenging situation and calls for the best and most stringent conservation measures. What is crucial is generating awareness of the manner in which water is used today; this will determine, to a large extent, its availability for the future.

A considerable part of the freshwater used in the South Asian region* is drawn from its rivers and lakes. Most of the river systems are linked with the Indian sub-continent. The principal among these are the Ganga, Brahmaputra, Indus and the Meghna.

Of these, the Ganga has the largest drainage area, the Meghna receives the highest amount of annual precipitation and the Brahmaputra experiences the highest average annual runoff. Although the region receives good rainfall, most of the runoff consolidated as flood water during the peak monsoon season, flows out into the sea instead of replenishing the groundwater. This is due to a lack of storage structures in the catchment areas. Floods, therefore, are common in Bangladesh and India. There are many dams and reservoirs in the region, which act as sources of water, but there are environmental problems associated with them (e.g. Tehri and Narmada in India).

There are also a number of lakes in the region whose waters are utilised for drinking, irrigation, recreation and for fishing. The annual internal renewable surface water resources of the region (Table 9) - except Maldives - are estimated at 3,763 km3/yr

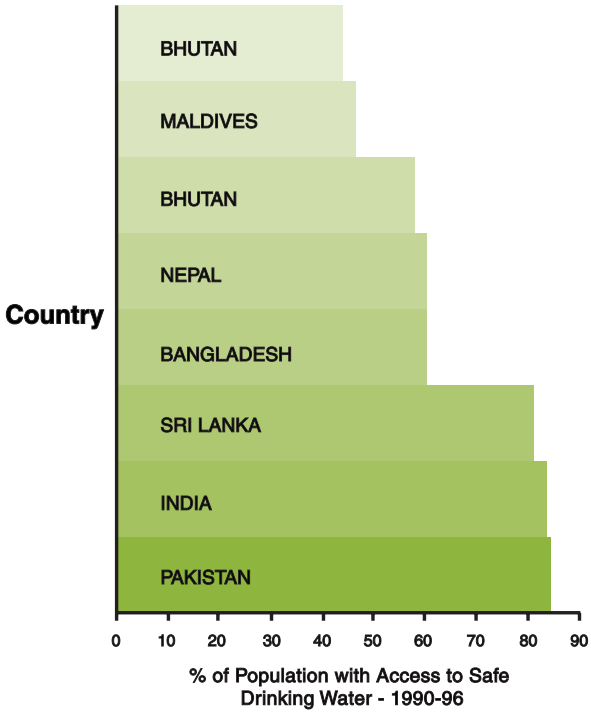
(*World Resources - 1998-99*).

Table 9 : Annual Internal Renewable Water Resources

Country	Total (*cubic km*)	1998 per capita (*cubic meters*)
Bangladesh	1,357	10,940
Bhutan	95	49,557
India	1,850	1,896
Nepal	170	7,338
Pakistan	248	1,678
Sri Lanka	43.2	2,341

Source: World Resources- 1998-99

WATER SECURITY



Source : World Development Indicators, 2000

Many countries in the region have large and extensive groundwater resources. This is because one of the world's largest river networks is present in this region. Bangladesh meets most of its water needs from its groundwater resources. In the island nation of the Maldives, groundwater is found in freshwater lenses underlying the atolls floating on top of the saline water. However, large-scale abstraction of this water resource for drinking has depleted the freshwater lenses, especially in the capital city of Malé, causing salt water intrusion.

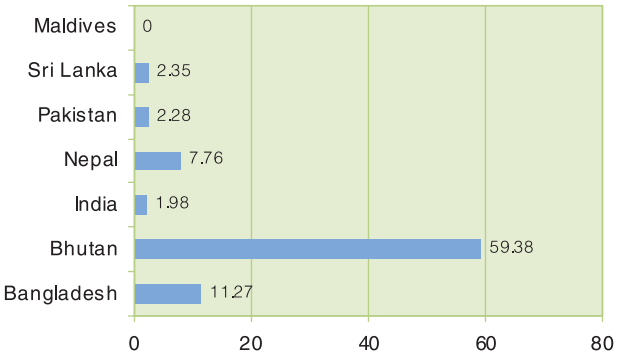
Per Capita Availability

Per capita availability of water can be linked with development (agricultural and industrial) and health status of any country. Generally, 1,700 cubic meters annual per capita of water is the desirable limit of requirement. When the availability of freshwater falls below 1,000 cubic meters per person per year, countries experience water scarcity; if it falls below 500 cubic meters per person, it leads to water stress.

Per capita availability also depends on climatic and geomorphologic conditions of the respective regions in a country, as well as the population pressure (*Engleman and Leroy, 1993)*. The South Asian region's water per capita is based on 1995 population statistics. As of

* Does not reflect data of Iran.

Water Per capita (000' cu. mt/year) 1995



Source : SoE Report on South Asia and the Pacific, 1995

today, countries such as Bangladesh, Pakistan (the Baluchistan region) and India (the state of Rajasthan) are facing water scarcity irrespective of annual per capita availability due to uneven distribution of rainfall and existing geological formations.

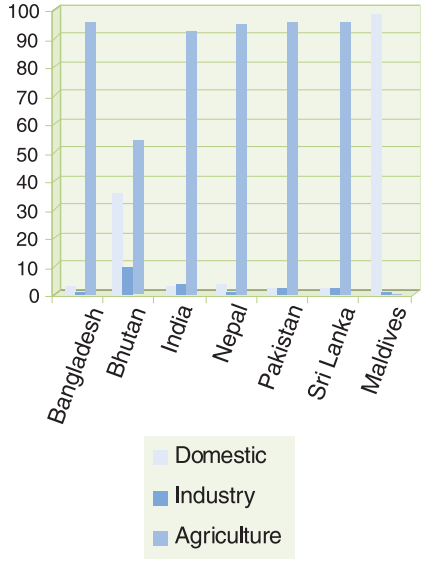
Increasing Thirst - Demand

Sectoral water use:

The available water resources in the region are used by the agricultural, industrial and domestic sectors, whose demands are increasing every day. This is due to soaring population growth and diversification of the activities into other sectors (e.g. urbanisation and industrial growth). Drinking water supply has a higher priority than agriculture, but the lion's share of water is still utilised by agriculture. There is also an increasing demand for hydroelectric power for industrial development.

The amount of water used by different sectors is reflected in the graph.

Sectoral Water Withdrawals - South Asia - 1997



Source: WRI, 1994-95 , & AQUASTATE

Irrigation-dependent agriculture:

The food security of the region is very much dependent on irrigated agriculture. Except in Maldives, the irrigation sub-sector in the region claims the highest use of water, accounting for over 90 per cent of the total annual available water.

The countries in the region are mostly agricultural economies. Agriculture contributes 40-50 per cent of the Gross Domestic Product (GDP) and provides nearly 70 per cent of the rural employment. In Nepal, agriculture contributes about 42 per cent to the GDP and provides employment to more than 80 per cent of the working population. In Bangladesh, foodgrains predominate, with rice comprising over three-fourth of the 9.6 million-hectare net cultivable area. Pakistan's agriculture is almost wholly dependent on irrigation - irrigated land supplies more than 90 per cent of the agricultural production and 70 per cent of all import earnings are derived from agriculture. Ninety-five per cent of the country's water resources are used up by

Drought affected agriculture land
Source: Bangladesh:State of the Environment 2001

the agricultural sector. In India, more than two-thirds of foodgrain production is from the 91.8 million hectares of land under irrigation; irrigation uses up nearly 90 per cent of the water supplies. Even when all the irrigation potential is developed in India, more than 60 per cent of the cultivable land will still be under rain-fed cultivation. Water is thus a serious constraint for expanding the irrigated area.

Large quantities of water that is used for agriculture is wasted and results in problems such as waterlogging and salinisation (*see chapter on Food Security*). The demand for non-agricultural uses is also increasing rapidly. At the same time, more food has to be produced to meet the demands of the increasing population and its burgeoning consumption levels. To counter these issues, there is a need for using the available water very efficiently - by using less of it to produce more.

Urban growth and water consumption:
The primary source of municipal/domestic water is surface water. However, most of the countries in the region are drawing water from groundwater sources as well, wherever it is available. There are some cities in the region which are exclusively dependent on groundwater, such as Lahore (completely dependent) and Dhaka (95 per cent requirements met by groundwater) (*Asian Development Bank, 1993b*).

Groundwater is very useful because of its better quality compared to water from surface sources. In general, groundwater is free from bacteriological, physical and chemical contamination and is also disaffected by short-term droughts. However, due to geological reasons, some of the areas have reported groundwater quality problems, such as the presence of flourides (India), nitrates (Nepal and India), arsenic (India and Bangladesh), chromium (Sri Lanka) and iron (Chittagong, Sylhet and Rajshahi in Bangladesh and some pockets in India) in the water. India, Pakistan and Bangladesh also face the problem of groundwater salinity in some areas.

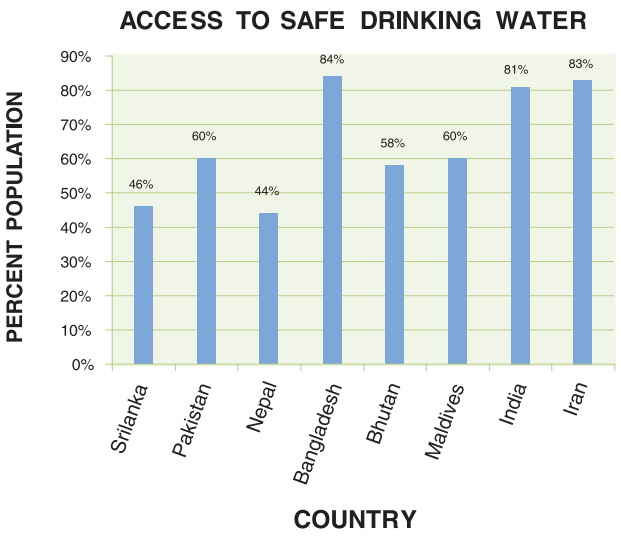
There is a lot of variation in consumption patterns of water among the rural and urban populations. According to an Asian Development Bank report, in the metropolitan centres, usage ranges from 100 to 400 litres per day (in New Delhi, it is 341 l/d), whereas rural water consumption is 40 to 60 l/d. Island nations such as Maldives have low per capita consumption (*ESCAP 1994*).

Industrial growth and the demand for water:
Groundwater is the main source for meeting the water needs of industries in this region, where industrial growth has been high (5.6 per cent between 1965 and 1990). In fact, the industrial sector has quadrupled in size. There has been a region-wide structural shift towards increased industrialisation - industry has increased its share of total output from 21 to 26 per cent. This structural shift is expected to continue in future (*World Bank, 1993*). The environmental cost of this rapid industrial growth has been the contamination of water resources, including pollution of groundwater and surface water.

Industry uses water mainly for cleaning and cooling purposes. Water-using industries in the region are pulp and paper, power, food processing, textile, chemicals, metals and petroleum. According to an *ESCAP* study, 50-80 per cent of industrial water supply drawn from groundwater is used by energy and fossil fuel industries. But the water that is returned to the source after use is heavily polluted with chemicals and industrial wastes, which, in turn, pollutes the groundwater aquifers. The reason for this state of affairs is a lack of treatment measures, which in turn, affects human health and causes soil degradation in the region.

Increasing demand for drinking water:
According to a recent study by the International Management Institute (*Sekler et al, 1998*), about 1.4 billion people - some 270 million in urban areas and close to 900 million in rural areas (*World Development Indicators, 1999)* - amounting to a quarter of the world's population or a third of the population in developing countries, live in regions that will experience severe water scarcity within the first quarter of the next century.

A view of wetlands in dry season
Source: Bangladesh:State of the Environment 2001



Source: World Development Indicators 2000

About one billion people live in arid regions which are projected to face absolute water scarcity by 2025. These regions do not have sufficient water resources to maintain 1990 levels of per capita food production from irrigated agriculture even at high levels of irrigation efficiency, and also meet reasonable water needs for domestic, industrial and environmental purposes.

About 348 million more people face severe economic water scarcity. They live in regions where the potential water resources are sufficient to meet reasonable water needs by 2025, but they will have to embark on massive water development projects to achieve this objective.

Mismanagement of Water Systems - Supply

Besides natural scarcity, mismanagement of water resources too plays an important role in causing water insecurity. Effluent discharge and indiscriminate extraction from aquifers are just a few of the many elements of this mismanagement.

Wrong practices and obsolete water distribution systems:

The rapid growth in the region's population has resulted in a decline in the annual per capita availability of freshwater. Chronic shortages of freshwater of adequate quality are already being experienced. Water quality has been steadily degrading due to a combination of factors such as draining of sewage and industrial, urban and agricultural effluents into water sources, and saline intrusion. In addition, migration of rural populations to urban areas and cities has been on the rise, which has increased the gap between water demand and supply. Considerable advance planning is required to overcome these problems.

In many areas of the region, the misuse of water resources has already resulted in depletion of aquifers, resulting in shrinking inland lakes and streams to unsafe levels. Per capita consumption figures are generally based on the quantity of water supplied to the water distribution networks in urban areas. But the distribution systems are obsolete and the losses and operational wastages are high. For instance, in Dhaka city, the unaccounted for loss of water is at least 45 per cent - out of which 20 per cent is physical loss and 25 per cent is administrative. This situation can be rectified through better maintenance systems, which can enhance the per capita availability.

Over-extraction of groundwater: Groundwater extraction for irrigation and drinking purposes is very common in India, Bangladesh and Pakistan. The region has been experiencing a fall in groundwater levels and deteriorating water quality on account of over-exploitation. Groundwater withdrawals have exceeded the rate of recharge and as a result, in coastal areas, the ingress of seawater into the aquifers is a common phenomenon. Over-abstraction from groundwater has dramatically lowered freshwater lenses in the Maldives. Most of the cities in coastal areas in the region are facing seawater intrusion due to over-abstraction of groundwater. Intrusion occurs when the water levels in freshwater aquifers are lowered to a point where salt-water can invade aquifers bearing freshwater. As groundwater is extracted from wells, the salt-water slowly moves through water-bearing beds in the direction of the wells. Such contamination manifests itself in gradual increase in the salt content of the water being abstracted.

Over-abstraction is a common phenomenon in India (parts of Tamil Nadu and Gujarat). The pricing policies and subsidies for electric power for withdrawing groundwater too have led to over-exploitation. In Dhaka (Bangladesh), the groundwater table has gone down to 25 m due to over-exploitation. Excessive pumping has led to mineralisation (arsenic contamination) in Bengal (in India) and Bangladesh. Groundwater pumping is unregulated in most states of India especially in terms of spacing that has led to interface and hence, scarcity of water. Maharashtra in India is enforcing its groundwater regulations very effectively in respect of spacing of wells.

At present, the groundwater utilisation by all the countries exceeds the groundwater replenishment. To overcome the environmental consequences of this, there is a need to emphasise conjunctive use of surface and groundwater and initiate strict regulatory measures.

Deteriorating Water Quality

Rapidly deteriorating water quality is one of the most serious environmental problems in South Asia. High population densities, unsustainable agricultural practices, rapid urbanisation, increasing industrialisation and a general lack of pollution control facilities are exerting growing pressure on the water resources. The severity of water quality problems in the region is summarised in *Table 10*. If allowed to persist, this increased pollution will reduce the amount of water available for use in future.

Inadequate treatment facilities:

As cities and industries in the region continue to expand and remain without proper waste treatment plants, rivers and streams are being used increasingly as

receptacles for their wastes. Almost 90 per cent of the wastewater in the region is discharged directly into the streams, rivers, lakes and coastal waters. The water in the region is most severely polluted by organic matter from sewage and processing industries such as food.

Surface water contamination:

Among the South Asian countries, India perhaps has the most contaminated rivers. About 70 per cent of the country's surface water is polluted. Out of some 3,119 towns and cities, only 217 have partial or complete sewage treatment facilities. The Ganga, one of the most celebrated rivers in the world, exemplifies the problem. Almost 600 of its 2,525 km-stretch is dangerously polluted with human and animal wastes and with increasing amounts of toxic and hazardous effluents from industries and agriculture, which are discharged from about 114 cities on its banks. More than 50,000 inhabitants dump untreated sewage into the river each day. As per the data generated by Central Pollution Control Board from its 270 monitoring stations across 28 major Indian rivers from 1971-1991, the minimum and maximum coliform values have demonstrated 30-fold and 1,00,000-fold increases, thus indicating the severity of the pollution. The river Yamuna passing through Delhi receives nearly 200 million litres of untreated sewage every day. Similarly, the Lyari river which passes through Karachi, Pakistan's largest industrial city, receives raw sewage and untreated effluents from 300 major industries.

In Sri Lanka, high nitrate levels found in the Jaffna peninsula and in Kalpitiya, though non-toxic, could have an impact on infant mortality and incidence of malignant tumors. Besides, most human waste in the country is discharged untreated into rivers. For example, in Colombo 75 per cent of sewage is discharged untreated into the Kelani river (*International Institute for Environment and Development, 1992*).

Lakes all around Colombo are becoming severely polluted. Mass fish mortality in the Beira Lake has been correlated to high organic content and the absence of dissolved oxygen. Similarly, lakes in many cities of India are facing eutrophication. The list includes lakes such as the Dal in Kashmir, Ulsoor in Bangalore and the Fatehsagar in Udaipur. In each of these cases, the indiscriminate dumping of untreated sewage into the lakes and also their gradual reclamation for development purposes is killing them.

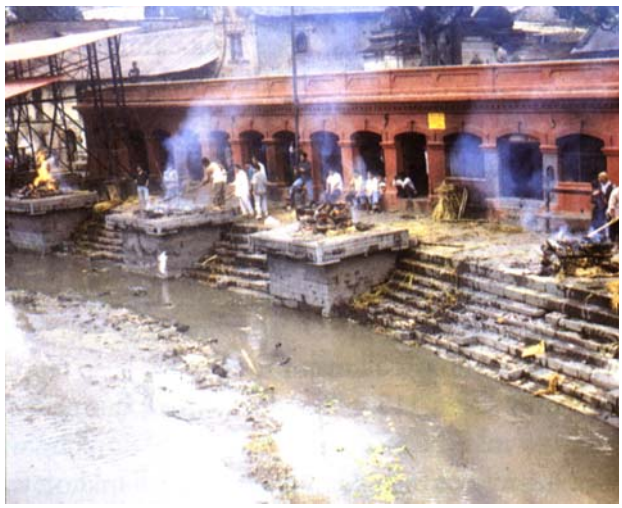
In Nepal, although vast sums of money have been spent on restoring the quality of the rivers in the Kathmandu valley, they are still being used to dispose off the sewage of the city's 1.5 million people. Industrial waste is also dumped into the river.

The data in *Table 11* shows the increase in the discharge of organic water pollutants from 1980 to 1997 in the region.

Table 10: Water Quality Issues

Quality Issues	South Asia
Pathogenic agents	1 - 3
Salinisation	0 - 1
Fluoride	0 - 1
Heavy metals	0 - 1
Sediment load	0 - 2
Organic Matter	1 - 3
Nitrate	0 - 1
Eutrophication	0 - 1
Pesticides	0 - 1
Acidification	0

Note : 0 - No pollution or irrelevant.
1 - Some pollution, water can be used if appropriate measures are taken;
2 - Major Pollution;
3 - Severe pollution affecting basic water uses



Polluted water in the holy River Bagmati near Pashupati temple, the most sacred site in Kathmandu (M. Khadka)
Source: Nepal:State of the Environment 2001

Table 11: Discharge of Organic Water Pollutants

Region	Organic waste pollutants *kg/day*	
	1980	1997
Bangladesh	66,713	1,86,852
India	14,22,564	16,64,150
Nepal	18,692	26,550
Pakistan	75,125	11,4726
Sri Lanka	30,086	55,665

Source: World Development Indicators 2000

Impact on coastal waters:
The South Asian region has a 10,000 km-long coastline. Large numbers of industries, power plants and aquaculture farms are found along the coast, especially in the subcontinent of India. Of concern are the large amounts of toxic wastes which drain into the sea in large amounts and persist there for long. The Thane-Belapur industrial area in the state of Maharashtra in India is the largest industrial estate in the region with a turnover of more than Rs 4,000 crore. The area is located along the Thane creek near the Arabian Sea. The 1,200 odd industrial units in this area dump 25,000 cu. m. of wastewater into the sea. Studies have indicated the presence of heavy metals such as lead and cadmium in the creek. The sea is believed to be polluted up to five km.

Another example of environmental nightmare is the Alang, the largest ship-breaking yard of the world situated in the state of Gujarat on the west coast of India. The 11 km-coastline of the yard has been severely polluted due to the scrapping of hazardous container ships. The coastal waters of the Indian cities of Panjim, Puri, Thiruvananthapuram and Cochin are also contaminated with untreated chemical wastes and discharge of oil and petroleum from ships which come to dock here.

Impact on groundwater quality:
Groundwater, which has long been the primary alternative to polluted surface water, is being increasingly contaminated by human waste, leaching of chemicals and saline water intrusion, as a result of over-extraction. A report published by the Central Pollution Control Board in December 1995 identified 22 places in 16 states of India as critical sites for groundwater pollution. Most of these places have industrial units dealing in pharmaceuticals, paints and dyes, chemicals, pigments, metal treatment, etc. A survey of groundwater has shown the presence of salts, toxic organics, pesticides and heavy metals such as cadmium, arsenic and mercury in large quantities. In Nandeswar Industrial Estate near Vadodara in Gujarat (India), groundwater is said to be contaminated to a depth of 60 m.

Water quality and changes in land use:
Many of the trends in water quality can be attributed to large-scale changes in land use, including deforestation and the loss of wetlands. Rapid population growth, which to a large extent has contributed to unsustainable farming practices and deforestation in Nepal and India, has reduced the water-absorbing capacity of the land in the Himalayan watershed that floods the Ganga and Brahmaputra rivers.

Changes in land use patterns brought about by urbanisation affects the recharge of groundwater. Urban run-off which collects toxic compounds from sewage, vehicular exhaust and industrial pollution severely degrades the water quality. Groundwater in most urban areas of Nepal is contaminated due to seepage from septic tanks. Private septic tanks are built by virtually all residents in Kathmandu on small plots of land, without sufficient room for soak pits. The semi-treated effluent, which is still toxic from the tanks, cannot find adequate area for dissipation and becomes concentrated in residential yards.

Catchment degradation due to commercial deforestation and overgrazing in Nepal and clearance of land for agriculture in Sri Lanka is increasingly leading to siltation of reservoirs, streams and rivers in these countries. Degradation of catchments and lack of proper watershed treatment can be seen throughout South Asia.

Impact of agricultural practices on water quality: The South Asian economy is agriculture-based. The use of fertilisers in the region has increased almost by 500 per cent since 1970 (*Table 12*). Evidence is now available which says that the leaching of fertilisers into water bodies and groundwater is a significant source of water pollution. In particular, excessive levels of nitrates and other nutrients resulting from fertiliser application are a major source of eutrophication in surface water throughout the region. While contamination of the region's water sources is by far the most significant impact, the release of nitrogen-based gases and ammonia can potentially contribute to both the greenhouse effect, and also to the depletion of the earth's ozone layer.

Table 12 : Fertiliser Consumption, 1968 -70 to 1988-90 Unit : 000 tonnes

Region	1968-70	1988-90	% change
South Asia	2,622	15,914	507
World	64,200	1,42,219	121

Source : FADINAP (1992)

Pollution caused by the leaching of nitrogen fertilisers has also been detected in the groundwater in many parts of India. In Haryana, for example, a well was reported to have nitrate concentration ranging from 114 mg/l to 1,800 mg/l, far above the national standard of 45 mg/l (*World Resources Institute, 1994*). Nitrate pollution also exists in groundwater in Nepal and Pakistan. In Sri Lanka, poor fertiliser storage facilitates leaching and contamination of the groundwater (*International Institute for Environment and Development, 1992*).

Intensive, cultivated fields contribute chemical fertilisers to the Kodku River polluting its water,which at the same time is being used by local people for washing clothes and bathing (B. Pradhan)
Source: Nepal:State of the Environment 2001

Adverse Impacts of Deteriorating Water Quality on Health and Environment

Health impacts:

Groundwater is the main source of drinking water in India and Bangladesh. Consumption of contaminated water - which is poisoned by microbiological or chemical elements - has been responsible for outbreaks of acute diseases.

Arsenic contamination of groundwater has been detected in West Bengal in India and in those areas of Bangladesh that border India. Arsenic is found mostly in the shallow aquifer in this region. The arsenic concentration in these places is estimated to be in the range of 0.06 to 1.86 mg/l (WHO guidelines suggest a safe value of 0.01 mg/l). It is estimated that thousands of people are affected by arsenic poisoning and suffer from arsenical dermatosis. In Bangladesh, groundwater in 44 out of 64 districts is arsenic-affected and 40 of the 50 common diseases prevalent are due to the consumption of unsafe drinking water. Gastroenteritis and diarrohoeal diseases kill 250,000 children under five years of age annually and sap the vitality of young and the old alike. Today, arsenic poisoning in Bangladesh is considered to be the "biggest poisoning case in history".

In India, the presence of arsenic in groundwater is affecting 863 villages in eight districts of West Bengal. It is estimated that 200,000 people exhibit arsenic-related skin manifestations in this area. The reasons for the presence of arsenic in groundwater are still not clear. Some experts speculate that the cause may be depletion of the groundwater table, leakage of industrial effluents into the soil and excessive use of chemical fertilisers and pesticides.

Environmental impacts

Land degradation - salinity:

By far the most pervasive damage to land that stems from bad irrigation practices and deteriorating water quality is waterlogging and salinisation of the soil. In Pakistan, about 3 million hectares of irrigated land has been adversely affected by waterlogging and salinity, causing an overall annual economic loss of US $2 billion (*Institution and Leadership in Water Resource Management, LEAD, Pakistan*).

5th Citizen's Report: CSE, New Delhi

In India, nearly 44 million people are affected by water quality problems either due to pollution or the prevalence of fluoride, arsenic or iron deposits, or due to ingress of salt water. In over 16 states, water sources are replete with fluoride and 62 million Indians suffer from flurosis, with several dental and skeletal defects. Some 29 million people in Gujarat, Haryana, Punjab, Karnataka and Tamil Nadu suffer from salinity. It is estimated that in India, some 1.5 million children under five years of age die each year due to water-borne diseases. Water-borne diseases cost the country 73 million working days every year and US $600 million annually in health care and lost production.

Over-use of water, seawater ingression, drought: Over-exploitation of groundwater in regions around the sea (as in the states of Tamil Nadu and Gujarat in India) have caused ingress of seawater, which has further led to an extreme salinity of groundwater.

Responses

Water resources need to be managed both qualitatively and quantitatively due to their importance to economic development, and to the physical and social environments.

As discussed earlier, some of the significant problems in the region include growing water scarcity, deteriorating quality and sectoral conflicts in water allocation. These problems are evidence of the strains placed on the region's water resources by rapid population, urban and industrial growth. As the quality of the surface water in the region deteriorates at an alarming pace, the dependence on groundwater as an alternative water source is increasing. Therefore, strategies are essential for improving the efficiency of water use and conservation of water as a resource.

Water Management through Integrated Water Resource Management

Creation of River Basin Organisations (RBO) at the basin level to integrate all aspects of water management – namely, water allocation, pollution control, protection of water resources and mobilisation of financial resources – is important. A basin-wise analysis of the availability of utilisable water resources, demand levels and consumption patterns is also needed. Such an analysis would help in developing a Water Zoning Atlas to guide decisions related to siting of industries and other economic activities.

Although there are RBOs in every country (e.g. the Indus water treaty between India and Pakistan, the Ganges water sharing between India and Bangladesh, the Pancheswar Project for India and Nepal, the inter-state tribunals in India, etc), there is a need for improving their effectiveness. To achieve this, micro-catchment planning through rainfall/watershed management is necessary, using a ridge-to-valley approach by involving stakeholders at all levels. While adopting this approach, there is a need to address watershed equity among landowners at different contour levels.

The other methods of water management include introducing water-saving technologies (such as sprinkler and drip irrigation technologies) for irrigation and domestic use, and reviving the traditional wisdom of water harvesting systems for storage and utilisation.

Institutional Mechanisms

The main causes for water conflicts and inefficient water allocation is the lack of coordination among different organisations responsible for quality and quantity of water. There is a lack of institutional mechanisms and overlapping of responsibilities between various departments is the major bottleneck for getting data on water resources. There is also no processed information or data (qualitative and quantitative) for surface as well as groundwater available with any particular agency.

Institutional mechanisms, therefore, need to be fabricated at country, state, river basin and local levels for planning and management. A central organisation at country level and a coordination centre at the regional level can be established. The responsibilities of the country-level organisation should be to collect, compile and analyse data on a river basin and circulate it to the coordination centre for sharing information across the region.

The existing support systems and infrastructures have to be enhanced through skill development of the existing staff, provision of modern technology for collection and processing of data (i.e. using remote sensing applications), development of management information systems, and use of modelling and simulation exercises in preparing river basin planning and development by involving scientific institutes, consulting firms, government sector, NGOs, etc.

Water Quality Management

Water quality in the region is steadily degrading due to a combination of factors including saline intrusion, sewage effluent, industrial effluent and urban and agricultural runoff. Problem of pathogenic agents in water is particularly severe in India, Nepal and Bangladesh.

Inland water quality problems arise principally from two sources: from activities linked to sectors such as agriculture, urban development and industrial growth, and those caused by direct water resource management interventions. In order to improve water quality, both preventive and curative measures are required.

Sustainable agricultural practices should be introduced to protect freshwater sources from non-point source pollution. Creating awareness amongst farmers against the use of excessive fertilisers and introducing integrated pest management and other conservation farming techniques is necessary; these should be promoted through incentives coupled with effective training and extension programmes.

The region as a whole needs to develop a water quality monitoring strategy. Neighbouring countries which share a single water source will have to coordinate activities such as environmental pollution control and development of water resources. Focus should be on standardising environmental legislation in the region with reference to ecological standards, training programmes on EIA procedures, water quality management and industrial pollution control, as well as appropriate technology transfer within the region. Furthermore, the role of community and NGO participation in water management should also be encouraged.

Policy Responses

Broadly, the main water issues in the region are:

- Floods: They are a common threat in Bangladesh and the north-eastern and southern parts of India.
- Waterlogging and salinity problems: These problems affect 14 per cent of the irrigated area in Pakistan and 11 per cent in India.
- Over-abstraction of groundwater: This is mainly prevalent in India, Bangladesh, Maldives, Pakistan and Nepal.
- Water Pollution: India, Pakistan, Bangladesh, Nepal and Sri Lanka suffer from this.

The Dublin-Rio process and related forums have clearly indicated to the fragmented, sectorally-focussed development and management of water resources as the root cause of the problems that afflict water and its use in the region. Hence, there is a need for Integrated Water Resources Management (IWRM), with an emphasis on holistic and cross-sectoral approaches. This should include integration of natural resources with an emphasis on conservation and protection; evaluation of the quantity and quality of available water resources under alternative land uses; allocation of raw and reused water to competing uses and users; and development of water supply and demand management strategies and mechanisms to augment the welfare derived from scarce resources in a sustainable manner. The following are the key issues across all water sub-sectors that factor in the adoption of IWRM.

Water policies:

Most of the countries in the region have formulated national water policies, and some are in the process of developing one. The aim of formulating water policies is to meet the growing needs for supply, reduce capital investment, protect the quality of water and in turn, develop a sustainable environment. For a policy to be effective, it should be followed by strategic planning and a set of comprehensive guidelines and procedures for proper implementation. Also, the process of formulation of the policy and its implementation should be participatory and consultative to increase awareness, consensus and commitment among the stakeholders.

While preparing a water policy, a proper legal framework for regulating withdrawals of groundwater should also be put into place. Though efforts have been made to check over-exploitation of groundwater through licensing, credit or electricity restrictions, these have been directed only at the creation of wells. Even the licenses do not monitor or regulate the quantum of water extracted.

Existing policies:

In Bangladesh, a national water policy is being formulated by the Executive Committee of the Inter-ministerial National Water Council. In India, while a national water policy was formulated in 1987, some of the state governments have developed their own water policies. In 1997-98, the Water Sector Management Review, jointly with the Ministry of Water Resources of the Government of India and the World Bank, made suggestions and recommendations for updating the national water policy and the water laws for more effective development, use, management and protection of water resources of the country. Nepal also initiated its laws on water resources in 1992. These laws deal mainly with the Water Resources Act and the Electricity Act. Besides, there is an umbrella legislation in the form of the Environment Protection Act of 1996, which attempts to protect the environment, particularly the natural resources such as land, air, water and forests.

Although water resource management is a sectoral subject, it needs cross-cutting interventions in other sectors such as land, forestry, etc for sustainable development of the resource. Hence, before formulating new policies or reviving the existing ones, other sectoral policies need to be looked into and integrated as well.

Trans-boundary water sharing:

Development of large river basins requires consensus building and arriving at agreements through negotiations for sharing the resources within a country or with other countries. India has a good river network, where the rivers are either originating from or flowing through other countries such as Bangladesh, Bhutan, Pakistan and Nepal. Bangladesh has 57 rivers that originate from neighbouring countries (54 from India and three from Mynmar).

There have been some efforts at regional cooperation in this field. The Joint River Commission of India and Bangladesh has the responsibility of working out the modalities of sharing of the waters of common rivers, but an agreement has been signed (in 1996 at Farakka) that caters only to the river Ganga. The development of the Ganga basin requires multilateral cooperation among India, Nepal and Bangladesh. The Indus Water Treaty between India and Pakistan - for sharing the waters of the Indus - provides for a permanent Indus Commission with Commissioners appointed by both the countries. India and Nepal have already jointly undertaken the construction of the Pancheswar dam on the Indus, which forms a common boundary for the two nations.

Participatory approach:

A participatory approach is an important pre-requisite for sustainable water resources management. Programmes related to micro-catchment treatment began in 1995, with the main stress on community participation for effective sustainability. Presently, most drinking water and sanitation projects implemented by international funding agencies concentrate mainly on participatory approaches involving women as the stakeholders in planning, implementation and maintenance. These participatory approaches can be applicable to only small-scale projects related to drinking water or irrigation. Large or mega-irrigation projects are very expensive, and governments are responsible for their maintenance.

Lately, some countries such as India, Sri Lanka, etc have been promoting Water User Associations (WUAs) for planning, implementation and maintenance. The objectives of the WUAs are to promote and secure distribution of water among users; to ensure adequate maintenance of the irrigation systems; to improve efficiency and economic utilisation of water; to optimise agricultural production; to protect the environment; and to ensure ecological balance by involving the farmers and inculcating a sense of ownership of the irrigation systems in accordance with the water budget and operational plan. The WUAs work on the basis of executive instructions/guidelines laid down by each state government. There is no central legislation or legal instrument in this regard. However, the only state in India which has passed legislation exclusively for farmers' participation in the management of irrigation, is Andhra Pradesh.

There is an urgent need for an awareness campaign to share experiences on the critical aspects of availability of water resource in terms of quality and quantity, conservation, etc. To achieve this, the services of Civil Society Organisations (CSOs) can provide a very important link between communities and government institutions. The CSOs can offer their services in capacity building of the relevant stakeholders, R&D for low-cost and effective water supply and sanitation facilities, and timely enforcement of policies.

Rationalising water pricing:

Demand management initiatives in the water sector are important, considering the increasing demand from various sectors. Demand management policies are normally constrained due to the existing pricing system for piped water supply in urban areas as well as in the agricultural sector. These tariffs are very old and do not even meet the operational costs. Moreover, the unaccounted for water wastage needs to be reduced by rehabilitating the existing infrastructure (leak detection, replacement of meters, involvement of stakeholders in operation, production and consumption, etc).

There have been no incentives for water conservation or for improving water use efficiency or productivity in the form of tradable water rights in irrigation schemes. Technology development and transfer programmes can help in reducing water usage and wastage. The augmentation of water supply through rainwater harvesting and recycling of wastewater also helps in meeting the water requirement to some extent.

Appropriate tariff structures for water services will have to be evolved to encourage wise usage of the resource and generate additional support for the fund-starved service providers. Additionally, there is a need to develop and implement cost-effective water appliances such as low-flow cisterns and faucets and formulate citizen forum groups to encourage and raise awareness on water conservation.

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1.3 Energy Security

Energy is a crucial determinant of development. Of all human activities, the production and use of energy has perhaps the largest impact on the environment. Increasing utilisation of energy by burning fossil fuels has been the major contributor to environmental degradation at local, regional, national and trans-national levels. While its extraction disrupts terrestrial and aquatic ecosystems, conversion and combustion for producing energy are the principal sources of greenhouse gases and other air pollutants. At the household level, indoor air pollution from the use of traditional fuels is a major health hazard. Thus, the need to use energy, while keeping its adverse environmental effects minimal, is a major challenge that faces countries at all levels of development. During the mid-1970s to mid-1980s, the concerns about energy were related to its availability, resulting in significant increase in prices. At present, the concern has shifted to considerations of environmental impacts of energy production and use.

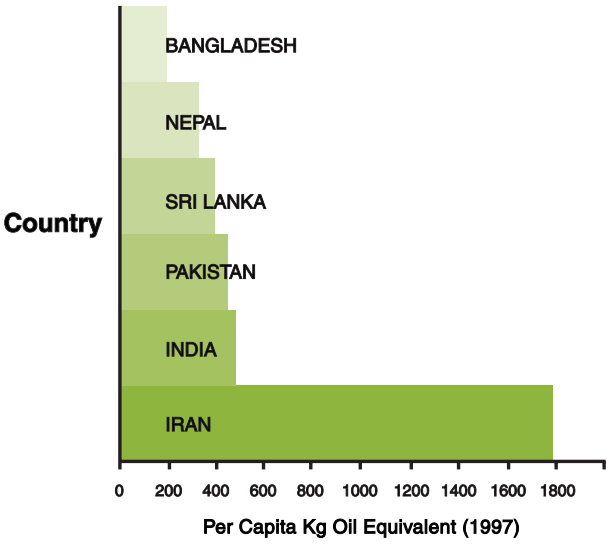
Overall, the use of commercial energy in the South Asian region* is expected to double during the 20-year period between 1990-2010. Power generation and transport are the fastest growing energy-using sectors. Growth in the power sector will lead to increase in coal consumption, and the growth in the transport sector will cause an increase in consumption of oil. Use of natural gas, nuclear and hydropower is also expected to increase substantially in the coming years.

Although limited at present, electricity generation from renewable energy has been increasing. The share of energy from solar photovoltaics has increased at a rapid rate in the South Asian region over the past decade.

Indoor air pollution
Source: India:State of the Environment 2001

This trend is expected to continue with the costs of photovoltaic systems coming down. However, currently, these are mostly restricted to remote locations far from the existing grids. The generation of electricity from wind has also been very successful and has seen rapid progress. India, for example, had commissioned about 54 MW of capacity by March 1993. There are plans to increase this to 5,000 MW. The role of the private sector in power generation in general is also on the increase throughout the region.

ENERGY SECURITY
(Commercial Energy Use Per Capita)



Data not available for Bhutan & Maldives
Source : World Development Indicators, 2000

Countrywide Sources of Energy in South Asia

There are quite revealing variations in the installed capacities of power utilities in South Asia as per their natural endowments.

The use of thermal power dominates in Bangladesh (92 per cent), India (73 per cent) and Pakistan (69 per cent). This form of power is proving to be highly cost-ineffective. India and Bangladesh use substantial amounts of energy derived from biomass and other renewable resources, putting great presuure on the forest and agricultural ecosystems that supply those fuels. In Nepal, 78 per cent of total fuel consumption is from fuelwood derived from forests.

Hydropower has been the most vital source of total installed capacity in Bhutan (100 per cent) and Sri Lanka (69 per cent). In India and Pakistan, the share of hydropower in the total installed capacity has gone down, but the total hydropower generation has

increased. In Maldives, the source of energy is from fuelwood and diesel-generated electricity.

Despite the emphasis on nuclear energy in both India and Pakistan, the installed capacity of nuclear energy has remained constant for the last 15 to 20 years. Though the nuclear power option is often considered to be safe, cheap and environmentally sound in South Asia, the capital costs of nuclear plants are two-thirds higher than those of coal-fired thermal power plants. Also, there are doubts about the safety of nuclear power plants.

Regional Surplus or Deficit in Energy

South Asian countries are largely energy importers. Due to excessive industrial and household demand, most of these countries face serious power shortfalls. The electricity consumption in different sectors in the region has been shown in *Table 13*. It is obvious from the table that industry is the largest consumer of electricity, except in Pakistan where it is the second largest. For the South Asian region, the demand for power has increased at an annual rate of 9 per cent, doubling its magnitude every eight years (*Energy Cooperation in South Asia, 1999, South-South Solidarity*). The supply side has, however, recorded a smaller and erratic growth pattern.

The energy deficit is likely to deepen further, both because of region-wide economic-liberalisation-led industrial activities, and rise in income level-led steady switching over of the rural and urban families from bio-fuels to more efficient and convenient modern fuels.

Environmental Implications of Increasing Rural, Urban and Industrial Energy Demand

The demand for energy can be broadly classifed into three generic classes: rural, urban and industrial energy demand. The demand in all these three sectors has increased in the South Asian countries. Per capita energy use in the South Asian region has increased to 443 kg of oil equivalent from 394 kg of oil equilvalent.

Use of commercial energy has recorded the maximum increase in Pakistan, where it has jumped by 4.9 per cent between 1980 and 1997. In the South Asian region, per capita commercial energy use is the maximum in India (479 kg of oil equivalent), but it still is much lower compared to per capita commercial energy use in USA or Australia where it is 8,000 and 5,500 kg of oil equivalent respectively (*World Development Indicators, 2000*). Average annual percentage growth in per capita comercial energy use during the period 1980 to 1997 has been the maximum (2.3 per cent) in Pakistan.

While the demand for energy is increasing, the production has not increased correspondingly. This has resulted in increased energy imports. From *Table 15,* it can be seen that Sri Lanka and Pakistan import 39 and 26 per cent of their total commercial energy use respectively.

Table 13: Electricity Consumption by Economic Groups in South Asia *(% to total sales)*

	Bangladesh	India	Nepal	Pakistan	Sri Lanka
Domestic	39.6	19.8	36.02*	40.5	26.0
Industrial	41.1	37.6	39.35*	26.3	18.2
Agriculture	8	29.6	-	18.2	-
Commercial	-	6.2	6.80*	4.6	16.3
Bulk supply & public lighting	-	4.5	6.41*	10.3	18.2
Traction	-	2.3	-	0.1	-
Export	-	-	8.8	-	-
Others	-	-	11.3	-	11.3

Source: World bank 2000, World Development Indicators, 2000
** Nepal SoE database, 2000*

Table 14: Energy Production and Use

Region	Commercial energy production		Commercial energy use			Commercial energy use per capita		
	Thousand metric ton oil equivalent		*Thousand metric* tons of oil equivalent		*Average* annual % growth	*Kg of oil* equivalent		*Av. annual* % growth
	1980	**1997**	**1980**	**1997**	**1980-97**	**1980**	**1997**	**1980-97**
Bangladesh	13,204	21,894	14,900	24,327	3.1	172	197	0.9
Bhutan	-	-	-	-	-	-	-	-
India	221,887	404,503	242,024	461,032	3.9	352	479	1.9
Maldives	-	-	-	-	-	-	-	-
Nepal	4,504	6,559	4,663	7,160	2.7	322	321	0.1
Pakistan	20,998	42,048	25,479	56,818	4.9	308	442	2.3

Source: World Development Indicators 2000

Rural energy demand:

A large proportion of the population of South Asian countries is from rural areas; for e.g., 70 per cent of the population in India and 85 per cent in Nepal is rural. Until the last decade, firewood and agricultural waste used to be the most important sources of rural energy. In recent years, electricity and petroleum products are increasingly becoming available in rural areas, but most rural communities continue to derive energy from 'traditional' sources such as firewood and agriculture and animal wastes. Though the use of commercial energy sources is growing rapidly in the South Asian region, one may expect a decreasing share of traditional fuels in the total energy demand. However, since per capita consumption of energy is much higher in the urban areas than in the rural ones, more than half of the population continues to rely on traditional fuels.

Impact on the ecosystem:

Dependence of the rural population on traditional fuels results in the depletion of forests, which in turn gives rise to problems such as soil erosion, loss of fertile topsoil, flash floods, reduced recharge rates, etc. The forests being important sources of carbon sequestration, the loss of forest cover results in accumulation of carbon dioxide in the atmosphere and in turn, global warming, sea-level rise and other associated impacts. Burning of biomass has another adverse impact - indoor air pollution.

(i) Deforestation: The production and burning of biomass has substantial environmental effects. Most of the biomass used is in the form of firewood. More than two-thirds of the wood removed from forests is for fuel. The forest cover in South Asia has reduced from 7,50,000 sq. km. in 1990 to 7,44,000 sq. km. in 1997.

Table 15: Net Energy Imports

	Net energy imports % of commercial energy use	
	1980	**1997**
Bangladesh	11	10
Bhutan	-	-
India	8	12
Maldives	-	-
Nepal	3	8
Pakistan	18	26
Sri Lanka	29	39

Source: World Development Indicators 2000

Fuelwood from the forest of Langtang National Park - what alternative source is there? (G.Joshi)

source: Nepal:State of the Environment 2001

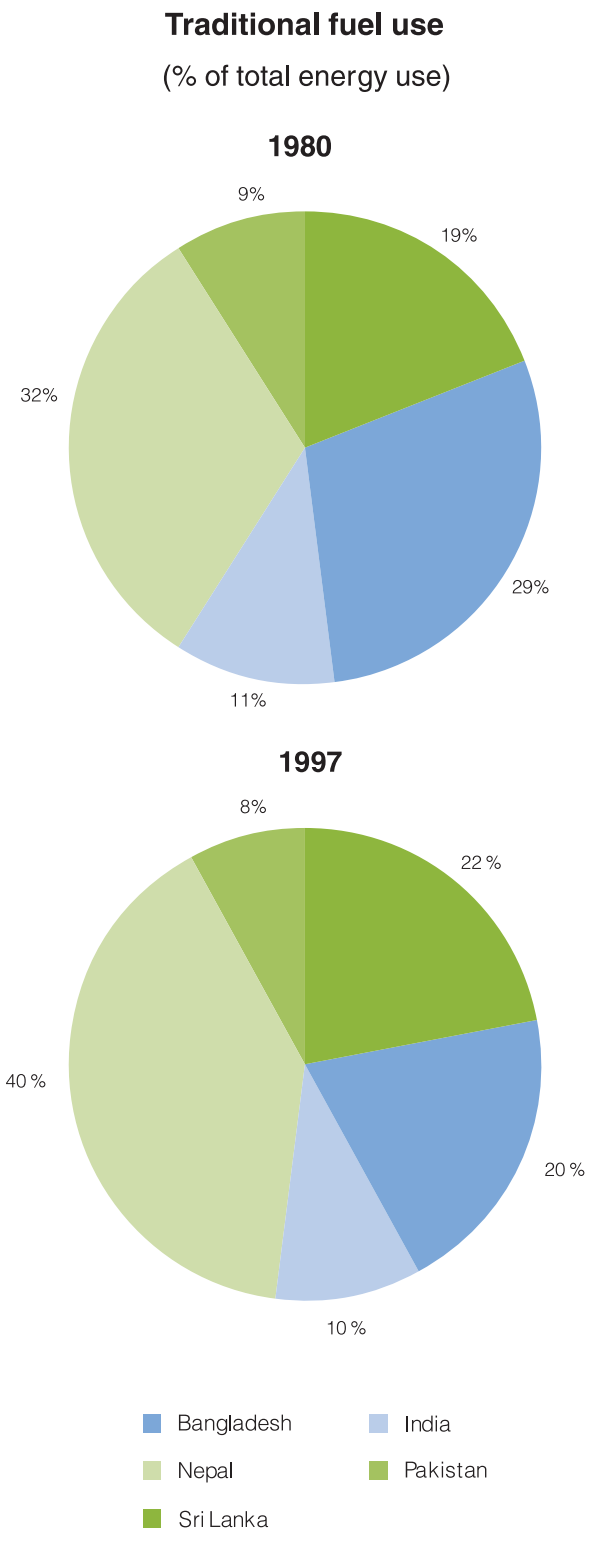
(ii) Loss of carbon sinks: As mentioned earlier, forests have got a strong potential to absorb carbon dioxide from the atmosphere and are thus considered as carbon dioxide sinks. Large-scale deforestation for fuelwood has led to the destruction of this sink, thereby causing an increase in concentration of the gas in the atmosphere. A higher concentration of carbon dioxide in the atmosphere is known to give rise to the greenhouse effect, thereby increasing the mean temperature of the earth's surface.

(iii) Indoor air pollution: Firewood burning generally leads to higher emissions of atmospheric pollutants per unit of delivered useful energy than fossil fuels. Furthermore, health impacts associated with indoor biomass burning are significant. A large proportion of the population still uses firewood for cooking. Consequently, women are habitually exposed to high levels of a range of pollutants, and their annual exposure is recorded to be several times more than that proposed by the World Health Organization.

In Maldives, diesel generators happen to be a major source of noise pollution, in addition to being a source of air pollution.

To address the problems associated with rural energy demand, some of the options available are biogas plants, solar cookers, improved *chulhas*, etc. Solar photovoltaic lamps can also be used for home lighting.

Large-scale awareness about deforestation, its implications, energy conservation, alternative and renewable sources of energy is very important. Despite the efforts taken up by the governments the results have not been very satisfactory. For example, the Ministry of Non-conventional Energy Sources in India started a programme to popularise improved *chulhas* (cookstoves) and realised a potential of setting up of 120 million improved *chulhas*. However, it could cover only 22 per cent of the potential during the period 1985 to 1997.



Source : World Development Indicator, 2000

Urban energy demand:

Urban lifestyle demands energy for various kind of uses – ranging from domestic and street lighting to home appliances, etc. With the increasing urban population in the region, the demand for energy has also gone up.

Industrial energy demand:

Energy being the most critical component for any kind of industry, the industrial energy demand in a developing region is bound to increase. Although other sources of energy undoubtedly have a role to play, a large proportion of this energy comes from fossil fuels. This puts immense pressure on the already constrained fossil fuel reserves. Besides, the other problems associated with the exploitation of fossil fuels, their processing, transmission and distribution remains a

concern. It is, therefore, important that while pursuing the developmental course these countries do not harm the environment.

Energy Production and Environmental Threats

In the early stages of industrialisation, local or global environmental issues were not a primary consideration and were often ignored in the face of the benefits of industrial development. Concern about the degradation of the environment began to grow, when the environment statrted showing signs of stress due to the intensity of industrial processes and other impacts, particularly owing to energy generation.

Sources of energy generation - environmental impacts:

(i) Environmental impacts of large thermal power plants: The South Asian countries still depend heavily on coal for production of electricity, despite the fact that production of energy from coal results in very significant negative environmental impacts relating to all stages of the coal-cycle including mining, transportation, combustion and the disposal of residues. To a smaller extent, oil and natural gas are utilised for energy production in thermal power plants. Their environmental impacts are discussed below.

Key impacts due to mining of coal include visual and landscape impacts, surface and ground water pollution and generation of leachate where coal awaiting transport is exposed to rain. Coal contains a large number of impurities, including heavy metals that are harmful to humans and aquatic life. The greatest environmental impacts from the coal cycle occur at the combustion stage. The emissions of particulates and sulphur oxides from coal-burning have been widely recognised as a major human health hazard.

Natural Gas is considered a highly desirable fuel compared to oil or coal since it results in less pollution per unit of energy delivered. Much of the supply of oil or natural gas takes place by pipeline. Environmental effects associated with the construction of pipelines are dependent on the terrain through which the pipeline is being laid. Special care needs to be taken if the pipeline is being laid in areas with sensitive ecosystems. In operation, oil and gas pipelines have only a minimal impact on the environment. However, accidents to pipelines, particularly offshore or in vulnerable areas, are a continuing source of concern.

Oil is the largest commodity in international trade, and oil tankers are a common sight in all parts of the world. About a third of oil slicks in oceans results from tanker operations. Tankers carrying liquefied natural gas (LNG) have had an excellent safety record to date. Although the probability of an accident is low, the potential consequence of an accident of a tanker carrying LNG could be very severe, particularly in inshore areas. Over land, leakage from storage tanks and their cleaning up also causes land and water pollution.

Sources have calculated that the emissions of SO_2 from Asian countries will almost double between 1995 and 2010.

Impact on air quality: In recent years, the regional and global aspects of coal use have become an increasing concern. Regional impacts result from emissions of sulphur and nitrogen oxides from combustion, giving rise to acid deposition. The nature and amount of coal combusted, prevailing wind directions, and type of soil and vegetation are amongst the important factors that determine the extent and impact of acid precipitation.

Emissions of greenhouse gasses (GHGs) and climate change: The global effects of coal combustion (and indeed, combustion of all fossil fuels and biomass) are associated with emissions of carbon dioxide and nitrous oxides, contributors to 'Global Warming'. The South Asian region is characterised by a low level of per capita emission. However, due to the dense population in the region, the total emissions of GHGs are quite high. *Table 16* gives the emission data of the countries with respect to the principal emitter, CO_2 and the intensity of emissions expressed in per capita as well as per unit of GDP. Comparing India, Pakistan, China and Uzbekistan one discovers that developing countries use more of fossil fuels per unit of their GDP, and their emissions per unit GDP are significantly higher than their per capita emissions. Paradoxically, USA has a per capita emission rate that is more than 20 times its GDP emission rate. This is more due to the fact that lifestyles in developed countries are highly energy-intensive.

(ii) Environmental impacts of large hydropower plants: Hydropower happens to be the best choice amongst other options, both in terms of cost-effectiveness and environmental safety.

Table 16: Selected Energy Indicators for 1997

Country	Electricity consumption* *(TWh)*	CO_2 emissions* *(Mt CO_2)*	GDP *(billion US$)*	CO_2 / GDP *(kg CO_2 / 90 US$)*	CO_2 /population *(tons CO_2 per capita)*
Bangladesh	10.06	20.91	30.14	0.69	0.17
Bhutan	-	-	-	-	-
India	382.18	880.71	445.92	1.98	0.92
Maldives	-	-	-	-	-
Nepal*	1.01	6,36,732	4.9	-	-
Pakistan	45.07	89.45	52.06	1.72	0.70
Sri Lanka	4.25	8.48	11.53	0.74	0.46
China	1069.94	3161.95	921.47	3.43	2.56
Uzbekistan	42.98	102.12	20.33	5.02	4.31
USA	3503.49	5470.49	6629.5	0.83	20.50

Source: International Energy Agency: Key World Energy Statistics,
**data from ICIMOD, Nepal*

The potential negative environmental impacts of hydropower plants include:

- disruption and resettlement of communities
- destruction/modifications of/to forests and wildlife habitats
- modifications to the hydrological regime

Large hydropower installations require significant areas of land and sometimes, prime agricultural land. In some cases, thousands of people need to be first displaced and then rehabilitated, leading to growing popular opposition to such projects. Although hydropower projects can have major impacts on the environment, the use of small or 'micro' hydropower schemes are likely to become an attractive means of expanding energy supply to rural areas.

(iii) Environmental impacts of nuclear power plants: Development of nuclear energy is at a low level in the South Asian region; India and Pakistan are the only countries that possess nuclear capacity. In routine operations, emissions from the nuclear power plants are small compared to those from fossil fuel plants. The major environmental concerns associated with nuclear power are:

- accidents resulting in deaths and long-term health impacts, and significant economic losses
- problems of waste disposal and long-term storage of radioactive wastes, some of which remain radioactive for hundreds of thousands of years
- operational releases of radionuclides during routine operation of nuclear plants resulting in localised health effects

The cost of generating electricity from nuclear power is far more competitive in relation with the use of imported fossil fuels. However, in countries that hold major reserves of good coal, nuclear power remains less competitive. The relative cost of nuclear and fossil fuel plants depends substantially on the cost of capital, since nuclear power requires a large amount of capital during the construction phase. Environmental concerns are also likely to have a strong influence on the relative attractiveness of electricity rather than coal, oil and nuclear power. The possibility of accidental releases of radiation and the safe long-term disposal of radioactive wastes, have to be weighed against emissions of air pollutants (particulates, sulphur dioxide, nitrogen oxides, etc), acid deposition and emission of the principal greenhouse gas - carbon dioxide.

(iv) Environmental impacts of cogeneration power plants: Even though the operation of solar power schemes is environmentally benign, the production of the metals (copper and aluminium) that serve as heat collectors and panel casings have significant environmental impacts. Some photovoltaic substances, such as cadmium sulphide and gallium arsenate, are hazardous to human health.

However, most renewable energy technologies, if carefully chosen and operated, have substantially lower environmental impacts than those associated with fossil fuels or nuclear power. At present, the largest obstacle to their widespread use is high capital cost. Greater use of renewable sources of energy is expected as their costs come down. With the increased concern about sustainable development and declining forest coverage, the role of traditional energy sources such as firewood

in the total energy supply will gradually decline during the next century. Due to the difficulty in supplying fossil fuels and electricity to many rural areas, it is likely that renewable technologies such as solar and wind power will play an important role in achieving this fuel switch.

Regional Initiatives (Programmes) for Cleaner Energy Generation

Renewable energy:

The South Asian region possesses vast stores of clean, renewable, non-conventional energy sources. These include biogas, solar photvoltaics, solar thermal, biomasss gasification, wind power, small hydropower and cogeneration. These sources are available throughout the region and thus, power generation is possible near the load centres - which takes care of the problems associated with transmission and distribution. Besides, these sources are also low carbon-dioxide emitters. In view of the issues linked to climate change, the decentralised energy sources seem to be a better alternative for sustainable development of the countries in the region.

Considerable progress has been made in India over a wide range of programmes, particularly in the production of electricity from renewable energy resources. Among renewable technologies, wind farms appear to be a feasible and cost-effective option for supplementing the conventional means of power generation on a large scale. The total installed wind power capacity of India is nearly 600 MW, which has placed India among the top three countries in the world in harnessing the wind resources. This capacity is expected to reach up to 2,000 MW by the turn of the century (*India's Ninth Five Year Plan*).

The renewables tend to be competitive vis-à-vis fossil fuel sources, especially in remote, sparsely populated locations, where it is not economical to extend the grid. Renewables thus have a large potential in meeting the development needs of small rural communities.

Energy efficiency:

Improvements in energy efficiency are frequently the most cost-effective approach to reducing the environmental impacts of energy systems, as there is usually a linear relationship between the amount of energy used and particular types of pollutants, e.g. particulates or sulphur dioxide. There is considerable scope in the South Asian region for reducing the amount of energy used across all sectors, including industry, transportation and household users.

Energy efficiency varies greatly both between the South Asian countries, and within individual nations. For example, the most efficient steel-producing plant in India uses about 10.3 gigacalories (gcal) to produce a tonne of steel, whereas the least efficient plant requires 20.7 gcal, about twice as much energy for the same output. The average corresponding numbers for Japan, the Federal Republic of Germany and USA are 5.5, 6.0, and 7.1 gcal/ton respectively.

Nepal: A Success Story

Nepal is the only South Asian country to have privatised its power sector and made significant progress through community-led action towards electrifying its villages. The source: micro hydel power.

Nepal is set among the majestic Himalayas with hundreds of rivers and streams that provide a huge potential for tapping power. The Nepalese government has ensured that there are no bureaucratic or policy-related obstacles that might stop it from doing so.

As a result, ever since 1984 when the government decided to delicense all electricity installations under 100 kw capacity, and backed that up with subsidy schemes providing for anything between 50 per cent to 75 per cent of the costs of generators and electro-mechanical parts required for the micro hydel projects, the number of such projects have been growing steadily. To cite an example: from the time when the first power project was built to illuminate the King's palace in 1911 till 1984, Nepal had a total of 250 MW of installed power. On the other hand, from 1995 to 2000, the country has seen an addition of an unbelievable 125 MW of power! The reason behind this change goes back to the government policy of 1984 and the community-led initiatives that it engendered.

The modus operandi is fairly simple. A typical Nepali village set in the mountains requires around 5 kw of power to supplement its basic energy needs. This is done through a micro hydel generator that taps the stream nearby. Site selection is done with the help of the sellers of the turbine, who also provide the technology, infrastructure needs and the equipment for the plant. Then the user group (the community that actually would be benefitted) puts up an application for loan with the Agriculture Development Bank of Nepal for approval. In this way, the user group also becomes the nodal body for implementation and operation of the project. The mechanisms for tariff payment and also for penalties and the process for conflict resolution are determined by them.

This is an excellent example of community participation resolving major resource bottlenecks through mobilised action.

Source: Down To Earth, December 1, 2000

Role of technology:

Realising the fact that unless industry and environment operate in harmony, the goal of sustainable development will elude us, the developed as well as developing countries are searching for newer ways of preserving the environment by conserving resources and minimising wastes in the process of industrial growth. The companies throughout the world are devising innovative approaches to become 'green and competitive'. Cleaner production, eco-friendly products, design for the environment and zero discharge are not just buzzwords today; rather, these are the emerging paradigms of corporate strategy.

The current technological revolution, well underway, leads to 'dematerialisation' of the economy and society in the sense that less and less resources and energy are required for each unit of the GDP. Developing countries and more so, the South Asian region, cannot ignore the implications of this revolution and should make use of this opportunity to gain profits from the technological improvements now achieved by the developed countries.

Climate change mitigation measures:

As mentioned earlier, the countries in the South Asian region are not highly industrialised. Many of the production systems in the region as well as the sources of energy function at low levels of efficiency. The Kyoto Protocol of the United Nations Framework Convention on Climate Change provides mechanisms such as Joint Implementation, Activities Implemented Jointly and the Clean Development Mechanism, which may be used for acquiring better technologies and a cleaner environment.

Table 17: Regional Trends in Transmission (T) and Distribution (D) Losses

Country	T and D losses *(% of output)* 1997
Bangladesh	15
India	18
Nepal	28
Pakistan	24
Sri Lanka	17
Low-income countries	12
World	8

Source: World development indicators, 2000

Energy Transmission and Distribution

Regional trends in transmission and distribution (losses):

Table 17 gives the complete picture – the transmission and distribution losses of 1997 for the South Asian region was easily more than double the world average. More importantly, it was more than 50 per cent in excess of the average for all the low-income countries put together. The best performing country, Bangladesh, is still a good one-third more than the average for the low-income countries, while the worst performer, Nepal, is 250 per cent more than the average.

The trend clearly shows that the solution for the region lies squarely in better utilisation of the existing capacities, rather than in adding to them. In fact, the data on the losses have been calculated as percentage of total output. As such, India which has a large decentralised energy consumption that is not grid-tied, has a lower transmission and distribution loss to show, whereas for its grid transmission the figure is more than 25 per

Table 18: Energy Indicators

Countries	Per capita energy consumption *(kg oil equivalent)*			Energy Intensity in GDP[a] *(toe/'0001993 US$)*			Net Oil Import Dependency (%)[b]		
	1985	1990	1995	1985	1990	1995	1985	1990	1995
Bangladesh	43	54	69	0.24	0.14	0.32	36.0	29.9	30.1
Bhutan	-	-	125	0.17	0.26	0.27	-	-	-
India	174	226	274	0.74	0.79	0.87	12.6	13.2	18.8
Maldives	114	141	253	0.19	0.17	0.25	-	-	-
Nepal	18	14	27	0.12	0.08	0.14	53.3	52	74.3
Pakistan	210	215	249	0.65	0.59	0.62	31.0	30.7	38.9
Sri Lanka	84	90	122	0.23	0.17	0.19	70.3	68.7	101.2

Source : http://internotes.adbedsd

[a] *Ratio of total primary commercial energy consumed to GDP at constant prices*

[b] *Ratio of Net Oil Import to Total Primary Energy requirements*

cent. With such high levels of losses in transmission and distribution, the extent of degradation of the environment and depletion of fossil fuel reserves that lead to no positive effect on the country's welfare levels can be assessed. In fact, if the losses are around the global average, then the need for burning more fossil fuels would largely be reduced, if not eliminated altogether. In addition, the countries can reduce their oil imports by promoting electricity, and replacing kerosene and diesel for rural enterprises and households.

Responses

Stepped Phasing out of Energy Subsidies

One of the major controversies that is fast gaining ground after the power sector was opened for private sector participation is the issue of loss to the state exchequer caused by protracted subsidies given by the state to various categories of activities and goods. In addition, most if not all the South Asian states cross-subsidise energy consumption in the agricultural and rural domestic sectors by 'taxing' the industrial and commercial consumers (*World Energy Outlook, 1999*).

Rational Energy Pricing

For independent power producers, especially those in the renewable energy sector, the power policy in the region offers higher than normal prices. For example, Independent Power Projects producing power from wind and hydro in India get paid at the rate of Rs 3.65 per unit when they are selling to the State Electricity Boards (SEBs). As against this, the SEBs charge a maximum of Rs 2 per unit from urban households. This implies losses for the SEBs and leads to market distortion, whose impacts are felt as and when these subsidies are withdrawn.

Renewable Energy Promotion as a Policy Solution

Utilisation of renewable sources of energy for power generation could help address the problems of depleting resources and emission of greenhouse gases. Of the various renewable energy options, wind, hydro and solar energy offer the highest potential. The South Asian region is well endowed with all of these resources. India possesses state-of-the-art technologies for producing renewable energy. It will be worthwhile to look for cooperation and joint efforts between different countries for exchange of expertise and technologies within the region.

Role of Climate Change Funds for Mitigation and Adaptation

The Kyoto Protocol of the UNFCCC provides mechanisms through which developing countries may get technologies as well as funds from the developed countries for adopting means of carbon emission reduction. The South Asian region can thus look at how these mechanisms may be utilised for the benefit of the region as a whole and the countries in particular. A common forum for negotiation in the global meets will strengthen the position of individual countries to a great extent. Within South Asia, Maldives is a vocal member of the alliance of small island states and climate change impacts may have serious consequences for this island country that is threatened by a rise in sea levels. Bangladesh too has similar concerns, and India's coastline is definitely under threat from potentially adverse impacts of climate change. Creation of a climate change adaptation and mitigation fund would not only assist the member countries in meeting exigencies arising out of disasters caused by climate change, but also serve as a negotiating mechanism in several global fora. Finally, it may facilitate the flow of funds for mitigating or adapting to the adverse impacts of climate change.

South Asia Energy Network, an Emerging Opportunity - a South Asian Grid

A common grid would allow for greater investment on transmission and distribution reforms that could be done across countries and thus, lead to an improvement in the energy situation. Nepal and Bhutan are cash-poor but have the potential for harnessing more power through exploitation of their hydropower sources. Bhutan has already become a significant exporter of electricity to India with the commissioning of the first two units of the 336 MW Chukha Hydel Project in 1986. As of 1996, hydropower generation accounted for one-third of Bhutan's annual foreign revenue (*National Environment Commission, 1998*).

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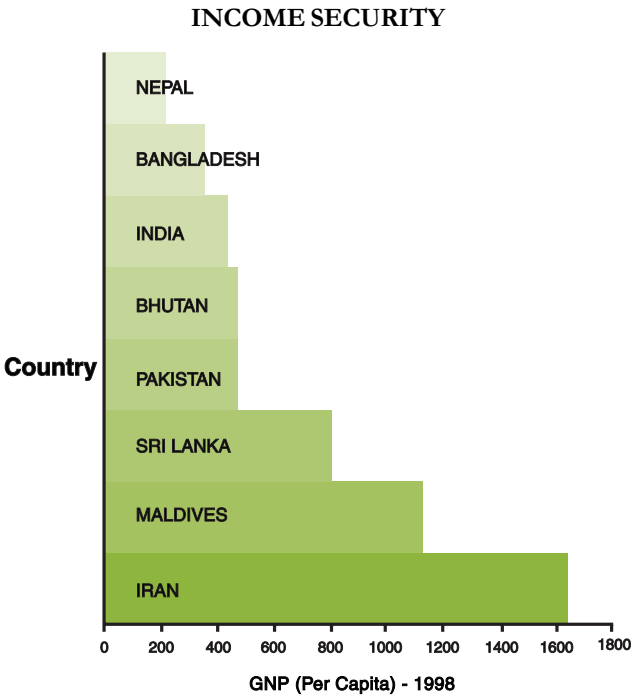
1.4 Income Security

South Asia* remains one of the poorest regions of the world inspite of its commendable growth rate in the last decade. The data below indicates that the region has been growing at an average rate of around 5 per cent annually for the last three years.



Source : Human Development Report, 2000

Table 19: Economic Indicators, South Asia

Item	1990	1997	1998
GDP ($ millions)	4,10,341	5,53,211	5,65,131
GDP growth (annual %)	5.6	4.6	5.6
Value added in agriculture (% of GDP)	30.0	27.0	28.3
Value added in industry (% of GDP)	26.5	26.0	25.0
Value added in services (% of GDP)	43.5	47.0	46.7
Exports of goods and services (% of GDP)	9.0	12.4	12.7
Imports of goods and services (% of GDP)	12.9	16.7	16.0
Gross domestic investment (% of GDP)	23.3	22.5	22.7
Central government revenues (% of GDP)	13.7	12.9	12.7
Overall budget deficit (% of GDP)	-7.2	-5.8	-5.4

Source : www.worldbank.org

Trends

Table 19 indicates that the GDP level in the region has grown at an average rate of around 4.7 per cent between 1990 and 1997. This region has, therefore, been one of the fastest growing economic blocks. However, in terms of the dollar-a-day benchmark, the region is also home to 40 per cent of the world's poor – about 522 million people according to 1998 estimates. Population growth is the single largest retarding factor which is inhibiting the growth process in the region.

Sectoral Employment Potential

The South Asian region has a large primary sector and a sizeable secondary sector in terms of employment potential. In the primary sector, fishing, mining and agriculture are the major occupations. The secondary sector has experienced a growth phase since the 1970s, although the onset date has varied for different countries. India, for example, experienced industrial deceleration for most part of the 1960s right up to the end of the 1970s, following which industrial growth rates picked up.

Of a more recent origin, high growth rates have been observed in the tertiary sector, which has now been rechristened as the services sector. A nineties phenomenon, the sector's growth process has been pioneered by the banking, transportation, fashion and the communication industries, the last named riding an unprecedented high on account of the information technology (IT) revolution.

Human-land Ratio

The total land area of the South Asian region is 41,46,820 sq. km. Population per sq. km. is staggeringly high - about 300 people. Given the fact that most of Nepal, Bhutan, upper India, upper Bangladesh and north Pakistan are covered by snow-clad mountains and the density of population is very low in these areas, the implication of the figure above is that there is tremendous human pressure on the remaining land. The human-land area mismatch debate that began in the 1950s as a livelihoods issue is slowly being augmented by the housing issue which has led to a burgeoning growth in the number of small and medium cities and townships (less than 2,00,000 people) in the entire South Asian region. This growth has led to an immense pressure on natural support systems.

Growing Numbers and Increasing Demand for Jobs

Poverty alleviation will continue to be the central agenda in the region for both governments and external donors. For example, reducing poverty through accelerated economic and agricultural productivity is the main thrust of the Bangladesh government's Fifth Five Year Plan (1997-2002). Poverty incidence in Bangladesh is targeted to decline from 47.5 per cent to 30 per cent by 2002, while the annual average GDP growth rate is set at 7 per cent, a level necessary to significantly decrease poverty. Halfway through the plan, growth had averaged only 5 per cent. What does not often get highlighted is the fact that domestic investment and national savings levels at the moment, at 22.8 per cent and 21.8 per cent of GDP respectively (1999), have reached fairly high levels. It may require disproportionate efforts to raise national savings any further.

As *Table 20* shows, the country with the highest per capita income in the region is Maldives, followed by Sri Lanka and Bhutan. The rest of the countries have a per capita of US $400 or less. The majority of the population is concentrated in three countries: India, Bangladesh and Pakistan. What this data shows beyond doubt is the fact that the South Asian countries, with the exception of Maldives, are low-income nations with high populations. This gives a low measure of income security for the region.

Table 20: Per capita income in South Asia

Country	GDP per capita *(dollars, current)*	
Bangladesh	337	(1998)
India	400	(1998)
Maldives	1,377	(1998)
Bhutan	480	(1997)
Nepal	222	(1998)
Pakistan	457	(1997/1998)
Sri Lanka	823	(1998)

Source : adb.org

In India, the population of the age group 15-59, which is considered to be economically productive, is likely to increase by 281 million during the period 1996 to 2016. Men and women of the age-group 15-24 are generally considered to be new entrants to the labour force. During 1996-2016, about 47 million persons will be added to this age group. Crude estimates arrived at by applying overall labour force participation rates observed in the 43rd round of National Sample Survey (NSS), to the projected rural and urban population of India, suggest that labour force will increase by 62 million in rural areas and 55 million in urban areas during the next two decades. It implies the need for creation of about six million jobs per annum on an average in the next two decades, if the present participation rate remains constant. The overall participation rate may decline due to the spread of education, but it is likely to increase due to a higher propensity to participate among women.

India's Eighth Plan had envisaged the generation of eight to nine million jobs in the first half of the Plan, and nine to 10 million jobs in the second half (*Planning Commission, 1996*). It implies creation of about 18-20 million jobs in five years, i.e. four million jobs per year. The Eighth Plan envisaged an average growth of 2.6 to 2.8 per cent in employment. Between 1987-88 and 1993-94, annual growth in employment was 2.33 per cent, falling short of the anticipated growth in the first half of the Plan.

Also, the unemployment rate of malé workers has increased from 5.54 per cent in 1987-88 to 5.91 per cent in 1993-94. In this situation, the ability to create additional jobs required due to population growth depends finally on the success of the New Economic Policy of the country. Apart from providing jobs, India also has the responsibility of supporting a growing aged population. In the next two decades, population aged 60 plus will increase from 62 million to 113 million - i.e., by about 2.5 million every year.

Agricultural growth rate is another area which relates directly to income insecurity. In India, for example, the fact that growth rates for agriculture have seldom surpassed that of the economy implies that wage levels in the agro-sector are further depressed. This leads to further income insecurity in the region, as agriculture is the occupation pursued by more than 50 per cent of the population, not only in India but across the South Asian Region.

Table 21 reveals that average growth rates in the agricultural sector have hovered around the 3-4 per cent level for all the countries, with the possible exception of Pakistan. As against this, GDP growth rates have been around the 5 per cent mark for these countries. The fact that the agricultural sector has not been the biggest contributor to the rises in national income levels, is reiterated by the higher shares of the secondary and service sectors in total national income.

Table 21: Growth Rates / Trends in Agricultural Production in South Asia

Country	1994	1995	1996	1997	1998	1999
India	5.4	0.2	9.4	-1.0	7.6	-
Bangladesh	-0.8	-0.6	3.4	6.1	3.0	3.5
Maldives *	2.6	1.6	1.7	1.3	2.9	-
Nepal	7.6	0.3	4.4	4.1	1.0	2.4
Bhutan	3.9	4.0	6.4	3.1	3.4	-
Pakistan	6.6	5.8	0.1	5.9	-	-
Sri Lanka	4.9	3.3	3.3	-4.6	3.0	2.5

Source : www.adb.org

** Maldives has data pertaining to the Primary Sector.*

Transitions in the Economy

The data above is indicative of the fact that the South Asian nations have been undergoing an economic transition: a move towards a more liberalised regime, ensuring greater competition and thus, better utilisation of scarce resources. In every walk of life, the indigenous, home-spun or home-made product is facing competition from machine-made products. Changing economic regimes of the 1990s have spelt greater income insecurity for the indigenous cottage industry which has been relegated to playing the unenviable role of a showpiece - a sort of vintage that needs to be preserved as national heritage. The net effect is that while cottage industry faces a dwindling market on one hand, rural economy faces a loss of alternative sources of livelihood options at the local level. The result is either impoverishment, a greater dependence on the natural resource base, or a move towards the bigger cities - generating problems of a different nature as would be discussed in the sections that follow.

Environmental Threats

Population and poverty:

The fast rising population (1.9 per cent per annum) in the South Asian region is the primary reason for the critical insecurity in income levels. The region is undoubtedly immensely gifted with richness as far as biodiversity, mineral wealth, potential for agriculture or water resources are concerned. Inspite of this, South Asia remains one of the poorest regions in the world, and this is largely due to the fact that it has a huge population to feed. The average annual growth rate of the labour force has been around 2.3 per cent per annum for the region, i.e. for a population of around 1.3 billion, the figure works out to be 30 million people. On the other hand, the generation of jobs in the region is around a tenth of the requirement (India creates around 15 lakh jobs a year). The fact remains that the region is simply not able to create enough opportunities for its people. With a high level of unemployment, out of which the major share goes to the primary sector, wage levels in the region are very low, thereby adding to the insecurity in incomes. Along with unemployment, underemployment has also been rampant in the region.

Table 22: State of Employment

Country	Employment in the primary sector *(% of total labour force)*		% of total unemployment in the primary sector *(by level of educational attainment)*
	% Male	% Female	
Bangladesh	54	78	47.4
India +	63	83	34.6
Nepal +	91	98	-
Pakistan	44	67	25.0
Sri Lanka	33	40	-

Source : World Development Indicators, 2000

(+ Indicates data pertaining to 1980; others are 1997 values)

The net result of all this is an overdependence on the natural resources of the region, which severely affects the environment. As a proxy measure of the pressure on the resource base, let us consider the population density per sq. km. of arable land. *Table 23* shows that the population density of the region as a whole is roughly about three times the average for the high income countries. Countries like Bangladesh and Sri Lanka have rural population densities that are significantly higher than other low income countries. The rates of growth of agriculture, given that more than 50 per cent of the population depends on this sector in the region, are also given to highlight the severity of the situation.

The high income average annual growth is roughly a third of the South Asian average: It adds up to about 580 people per sq. km. of arable land. Moreover, the agricultural population has a declining growth of 0.2 per cent. The high world average stresses on the fact that most of the people depending on agriculture as their source of sustenance, are from the developing countries. Income insecurity is particularly pronounced in the South Asian region (Sri Lanka and Bangladesh have a huge proportion of their populations in the rural areas) as a result of high population impinging on the scarce resource base. As a case in point, the total supply of arable land in India reduced from 54.8 per cent to 54.5 per cent of the total land area over a period of 17 years from 1980 to 1997. In concrete terms, this means a loss of around 0.97 (i.e. ~1) million hectares (*World Development Indicators 2000*). This demonstrates that low incomes have forced people to use land more intensively - whether for cultivation or grazing. In Bangladesh, the same indicator shows a decline of around 7.5 per cent, over the same duration.

In addition, between 1980 and 1997, the permanent cropland area has gone up for all the South Asian nations.

The population pressure on the resource base affects the environment in the following ways-

- It turns arable land area into wastelands or urbanised land, either as an effect of practising unsustainable patterns of agriculture or overgrazing or due to rampant urbanisation.
- The area under permanent croplands increases, thereby reducing the forest cover.
- Ever increasing population reduces employment opportunities.

Urbanisation:

Such a phenomenon witnesses a steady exodus of people out of the villages and into the cities. Correspondingly, a form of migration - for jobs - becomes common. The resultant impact is crowding of the urban areas, appearance of unplanned slums, creation of mega cities, and a general rise in pollution levels in and around the emerging metropolis. The urban population of Bangladesh grew from 12.5 million in 1980 to 29.4 million in 1998, i.e. roughly by 135 per cent. In the same period, India's urban population grew by more than 70 per cent to a total of 272 million. Nepal's urban population grew thrice in the same period, and Pakistan's had roughly gone up by another 80 per cent to almost 48 million people in 1998.

Cross-border migration:

Within the region, this phenomenon has mainly taken place between India on one hand and Bangladesh, Myanmar, Bhutan and Nepal on the other. Due to the vastness of the country, India has witnessed unwanted

Table 23: Population Density

Country	Rural population density *(people per sq. km of arable land) (1998)*	Avg. annual growth rate of rural population 1980 – 1998 *(%)*	Growth rates of the agricultural sector *(%)* 1997
Bangladesh	1,204	- 1.7	6.1
Bhutan	-	-	3.1
Maldives	-	-	1.3
India	431	1.6	- 1.0
Nepal	686	2.3	4.1
Pakistan	395	2.0	5.9
Sri Lanka	1,652	1.2	- 4.6
High income countries	***190***	***- 0.2***	-
World	**519**	**1.0**	**-**

Source: World Development Indicators, 2000

immigration through its porous borders. This process is also the result of domestic tensions in the neighbouring areas. For example, the Chittagong Hill Tracts problem in Bangladesh led to increased migration from Bangladesh into India. Such migration increases the local population, leads to a fall in the income levels in the area and creates internal security problems.

Response

Population Control

The need for awareness - income vs. the environment:

Any discussion of priorities for ensuring greater income security - for better environmental management in the region - would have to take into consideration the importance of generating awareness in large volumes. At the policy level, the issue of ensuring stability of income is still seen as a political issue and not as an environmental one. The fact that falling income levels or rising population levels would eat into the amount of resources available is still far from being perceived as it should be. Both in terms of primary resources (such as fuelwood, fodder and food) as well as other resources (such as electricity, water supply and sanitation), income insecurity would mean greater pressure on the state exchequer to provide the basic amenities to the people at affordable rates, or for free. In India, for example, electricity is free for much of the agricultural populace. The rationale for this is that farmers need to cut down on production costs so that they may be able to retain enough earnings to sustain themselves. However, the root of all evil is the lack of awareness, at all levels, about the severity of the poverty problem, and what are its possible repercussions on the environment.

Awareness generation, therefore, can be a potent solution. It pre-empts disasters, and this is more relevant in the case of income generation than anywhere else. The concern at hand is that as the numbers are too high presently, there is a need to curb population growth rates even more to ensure that the overall figure at a future date would be less alarming.

Family planning:

All countries and their governments have tried to check population explosion by highlighting the benefits of a small family. Issues have to be recognised as cost-effective measures to reduce population growth rates in the region.

Bridging the Gap between Employment, Availability and Requirement

The general plan for the South Asian region, based on the experiences of the member countries, emphasises the role of the private sector, especially in export-oriented industries, as the main engine for sustainable economic growth and employment opportunities. This will be facilitated by reforms in financial and capital markets. Since about 70 per cent of the population still lives in rural areas, self-sufficiency in foodgrains is emphasised for sustainable poverty reduction.

Some of the most important measures in the war against poverty are the creation of sustainable livelihoods through human resource development; promotion of small-scale enterprises through microfinance; participation of local-level institutions in rural development; and good governance. Prospects for poverty reduction in Bangladesh received a setback in 1998 because of heavy floods. Progress in the other countries of the region have also been slow despite substantial government efforts and resources that included allocating about a fourth of the annual development budget to social infrastructure. The use of the development budget allocated to social sectors and social infrastructure, therefore, needs to be extensively analysed and a strategy developed for increasing budget efficiency to reduce poverty in a cost-effective manner.

Some of the other planned responses and operational successes of response strategies are outlined below:

- Microfinance has been extended to a large segment of the rural population in the region. It is time to establish stronger ties between these small-scale enterprises and the formal sector by developing more effective marketing and distribution links with medium- and large-scale industries. NGOs set up to assist small-scale industries can play a key role.
- These links will also enhance the role of the private sector in poverty reduction through generating employment and income for rural small-scale industries, many of which are run by women. While the government has been actively promoting the private sector's role in the country's development efforts, progress in privatising state-owned enterprises has been slow.
- The current privatisation drive, which was observed in the 1990s across all the member countries, appears to lack its initial thrust. The bureaucracy, labour unions and politicians with vested interests still exert strong resistance to privatisation. However the trend seems to change for the better as more and more stress is

being accorded to greater autonomy and stakeholder participation, both in urban and rural areas.

To conclude, income insecurity in South Asia is intricately associated with the broader issues of population control and improved governance. The major sectors that need urgent notice include appropriate policy-making and governance that takes proper cognizance of the concerns of the majority of the population. Two issues stand out:

- Substantial state-owned enterprise losses continue to drain the budget, consuming funds that could otherwise be used for poverty reduction. The region's annual economic growth target of around 7 per cent, envisaged in India's Fifth Five Year Plan, remains unattainable. This is not because the region lacks economic potential, but because the growth prospects of the economy have been seriously clouded by internecine political conflicts, continuous general strikes disrupting work, endemic corruption, and the general lack of good governance. Unless the region's political leadership becomes more enlightened and seriously sets itself to the task of addressing these issues, the economy may remain mired in poverty and underdevelopment for years to come.
- At the heart of the low agricultural growth rates lie small farm sizes. The size of the farms being no bigger than two-three hectares, the possibility of introducing mechanised farming, which could be an escape route, is remote. It is up to the policymakers in these countries to try and introduce a proper incentive structure that would promote the growth of cooperatives. A third step, part of which is already in place in some of the countries, is for the governments to introduce minimum wages legislation and other similar measures to end capitalist exploitation of cheap labour in these labour-abundant nations.

References

- Websites: adb.org, worldbank.org
- World Development Indicators 2000, The World Bank, Washington DC

2.0 Environmental Disasters

Environmental degradation plays a critical role in triggering some disasters, and in making others worse. Countries that face severe deforestation, erosion, over-cultivation and over-grazing of marginal lands are hit hardest by catastrophes. For example, deforestation results in an increased concentration of surface run-off and hence flooding, and destabilised slopes can result in devastating landslides.

The incidence of natural disasters such as storms and floods is increasing in frequency and magnitude. Some of these phenomenon - particularly floods - are being exacerbated or triggered by human degradation of the environment and disturbance of formerly stable ecosystems. The summer of 1998 saw two major examples of flooding and landslide disasters in Asia that were caused by such environmental degradation - in both cases, the loss was of forests in the upland watersheds of major rivers.

The vulnerability to natural disasters is also growing due to increasing population and inadequately planned urban growth. The number and density of people living in cities within earthquake and tropical cyclone zones have risen dramatically in the past two decades. This growth has mostly been haphazard and uncontrolled. Physical infrastructure has expanded rapidly as well, and has generally hindered sustainable construction practises and safe building standards, particularly from the standpoint of mitigating events such as floods and earthquakes. Poor planning decisions have led to the establishment of potentially hazardous facilities, such as nuclear power plants, chemical factories and major dams, in earthquake prone zones and densely populated areas.

Empirical evidence suggests that countries which suffer most from natural disasters are those in which environmental degradation is most severe, i.e. those with severe deforestation, soil-erosion, over-cultivation and over-grazing (e.g., the 1993 floods in Nepal were mainly due to deforestation and alterations to natural catchment drainage patterns, which reduced the attenuation of run-off, and concentrated high run-off volumes over a short period of time although the actual intensity of the rainfall was not particularly severe).

The effects of environmental degradation can also transcend national boundaries. For example, increasing soil erosion in the hills of Nepal is resulting in heavy siltation of the river beds in India and Bangladesh, which is raising river bed levels and causing more frequent flooding. In the coastal areas, human vulnerability has increased due to degradation of the natural buffers, such as coral reefs and mangroves. This is particularly true in the region's island nations and the coastal areas, such as in Bangladesh. The region also witnesses the tremors of global ecological changes. For instance, the loss of natural vegetation - particularly forests - around the world is also a major cause of preventable natural disasters that afflict South Asia.

The Gujarat Earthquake

The earthquake that shook Bhuj in the Indian state of Gujarat on the morning of January 26, 2001 (India's Republic Day) is the most deadly earthquake to strike India in its recorded history. One month after the earthquake, official Government of India figures place the death toll at 19,727 and the number of injured at 1,66,000. Indications are that 6,00,000 people were left homeless, with 3,48,000 houses destroyed and an additional 8,44,000 damaged. The Indian State Department estimates that the earthquake affected, directly or indirectly, 15.9 million people out of a total population of 37.8 million. More than 20,000 cattle were reported killed. Government estimates direct economic losses at US $1.3 billion. Other estimates indicate losses as high as US $5 billion.

Source: http://cires.colorada.edu/~bilham/gujarat2001.html

Planning and preparedness is essential for both mitigation and management of natural disasters. Information about the measures to be taken before and after the event needs to be disseminated, implemented and followed carefully. However, in most developing countries of the region, even when adequate forecasting is available, conditions are such that the warning of an event is of little practical use. Due to overcrowding, lack of basic infrastructure and communication means, very little can be achieved by way of evacuating or preparing the population at risk.

Severe destruction
Source: Wetlands in danger, IUCN

2.1 Floods

Floods are usually considered the most destructive of all natural disasters. Not all floods bring disaster in their wake, though. The annual floods in Bangladesh deposit alluvial in the delta and assure the land's fertility, making it possible to grow three crops a year. The population density in the region is very high; demographers believe that if the land was not so fertile, less people would be attracted to live there.

Floods can be of different kinds, depending largely on the geographical, climatic and hydrological characteristics of the area. These include seasonal floods, urban floods due to inadequate drainage facilities, and floods associated with combined fluvial and tidal events, such as heavy rainfall coupled with wind-induced tidal surges. Seasonal flooding occurs in many of the large river basins of the region, such as the Ganga in India. Prolonged rainfall over an extensive catchment area generates high volumes of run-off, which spill out onto the river's natural floodplains. This water can inundate large areas for weeks at a time owing to the long response time of the catchment, and subsequent slow rise and fall of the flood hydrograph. For example, in Bangladesh, as many as 80 million people are vulnerable to flooding each year. In July and August, heavy monsoon rains combine with high river flows from India and cause serious flooding. Another example is India, where a total of about 40 million hectares are at risk from flooding each year. The average annual damage has been estimated at US $240 million, although this can increase to over US $1.5 billion with severe flooding.

Land is being abandoned and marginalised (ICIMOD)
Source: Nepal:State of the Environment 2001

Flash floods, resulting from intense rainfall of a relatively short duration, are more common in the hills and mountainous parts of the region that have steep and small catchments which respond quickly to rainfall, such as in Central Asia. However, they can also occur when dams or barrages fail. Located on the southern bank of river Brahmaputra in Assam, India, the Kaziranga National Park has been bearing the brunt of floods every year. According to an estimate by the wildlife reservation wing about 500 animals died in the 1998 floods. As many as 101 highly prized one-horn rhinos were swept away, reducing their already endangered population by half. The extent of damage was assessed at Rs 1 crore.

The July 1993 flash floods in Nepal were assessed as the most devastating in the last 40 years. Over 1,000 people died, about 39,000 houses were damaged, 43,000 hectares of topsoil was either washed away or covered by debris and 38 irrigation schemes were destroyed. The total cost of the damage was estimated at over US $200 million.

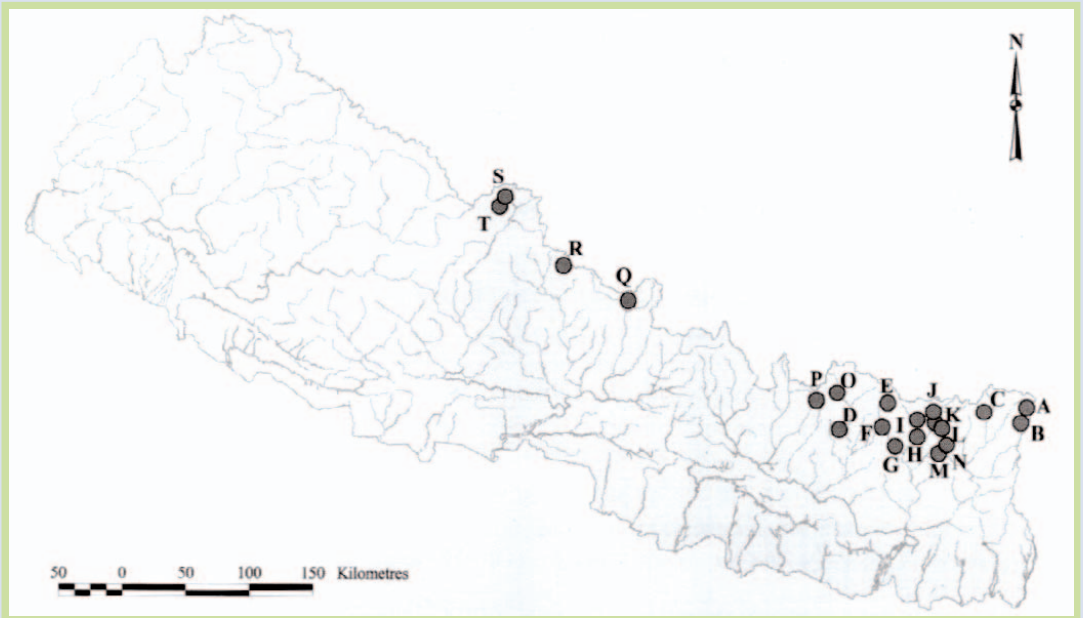
Another type of floods - Glacial Lake Outburst Floods (GLOFs) - is a major concern in the Himalayan region. This is the periodic release of large amounts of stored water as a cataclysmic outburst from a glacier. GLOFs are severe geo-morphological hazards and their floodwaters can wreak havoc on all human structures located in their path. Much of the damage created during GLOFs is associated with the large amounts of debris that accompany the floodwaters. One of the important reasons that causes rise in water level in the glacial lake, which in turn endangers the lake to reach the outburst stage, is rising global temperatures that rapidly melts glacial ice and snow. There have been several cases of GLOF in Bhutan and some in Nepal and India (*State of Environment Report 2000, Bhutan*).

GLOFs in Nepal

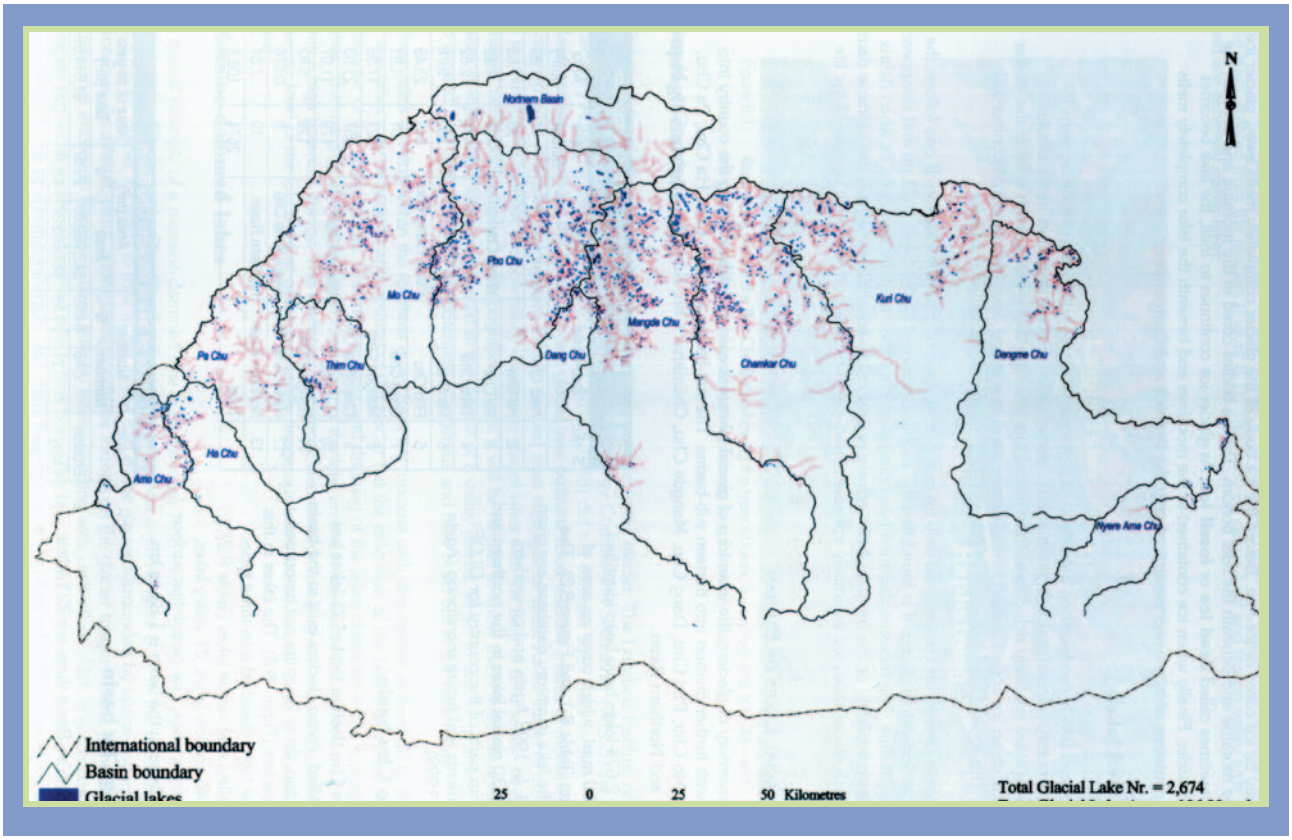
Records show that a GLOF has been occuring in Nepal with varying degrees of socio-economic impacts once in every three to 10 years. The International Centre for Integrated Mountain Development (ICIMOD) and the United Nations Environment Programme/Regional Resource Centre for - Asia and Pacific (UNEP/RRCAP) have developed a database of glaciers and glacial lakes in Nepal in 2000. The methodology for the inventory of glaciers is based on the Temporary Technical Secretary for World Glacier Inventory (1977). For glacial lakes, it is based on modification of the method developed by the Lanzhou Institute of Glaciology and Geocryology (1988). Topographic maps, aerial photographs and satellite images have been used in the inventory of glaciers and glacial lakes. The study recorded a total of 3,252 glaciers covering an area of 5,322 km^2 with approximately 481 km^3 of ice reserves in Nepal. The study also recorded 2,323 glacial lakes with an approximate area of 75 km^2. Based on the analysis of inventory data, 20 glacial lakes were identified as potentially dangerous in Nepal, out of which three (Nagma, Tam Pokhari and Dig Tsho) had past outburst records.

Glacial Lake in Nepal
Source: ICIMOD/UNEP

Potentially Dangerous Glacial Lakes in Nepal



A = Nagma pokhari (Tamor)
B = (unnamed) (Tamor)
C = Lower Barun (Arun)
D = Lumding (Dudh Koshi)
E = Imja (Dudh Koshi)
F = Tam Pokhari (Dudh Koshi)
G = Dudh Pokhari (Dudh Koshi)
H = (unnamed) (Dudh Koshi)
I = (unnamed) (Dudh Koshi)
J = Hungu (Dudh Koshi)
K = East Hungu 1 (Dudh Koshi)
L = East Hungu 2 (Dudh Koshi)
M = (unnamed) (Dudh Koshi)
N = West Chamjang (Dudh Koshi)
O = Dig Tsho (Dudh Koshi)
P = Tsho Rolpa (Tama Koshi)
Q = (unnamed) (Budhi Gandaki)
R = Thulagi (Marsyangdi)
S = (unnamed) (Kali Gandaki)
T = (unnamed) (Kali Gandaki)



Technical reasons why floods become tragedies concentrate on mistakes in land use: bad zoning, bad planning, bad agricultural practices (e.g. ploughing up and down a hill instead of along the contours) and above all, deforestation - itself connected to population pressures. Unregulated building on flood plains is another aggravating factor.

2.2 Drought

A drought triggers a crisis, but does not cause it. Over-cultivation and over-grazing weaken the land, allowing no margins when a drought arrives. Occurrence of drought is commonly associated with arid and semi-arid regions. Many countries in South Asia are prone to drought, including Pakistan, Nepal, India, Sri Lanka and parts of Bangladesh. In India, about 33 per cent of the arable area is considered to be drought-prone. The number of people at risk has been estimated at 185 billion. In Sri Lanka, the government provided relief to over two million people during the 1996 drought - i.e. about 14 per cent of the population. Nepal has been subjected to severe droughts during 1981-82, resulting in a 1.4 per cent decline in GDP.

2.3 Cyclones

Cyclones can generate very heavy rainfall and cause severe flooding, and are often accompanied by devastating tidal surges and raging cyclonic winds. In fact, most major disasters associated with tropical cyclones have been caused by tidal storm surges. When a tropical cyclone approaches the coast, storm surges can occur several hours in advance of the cyclone under certain conditions (primarily low central pressures, shallow waters and high tides), and hit a coastal area whilst people are still being evacuated, causing huge loss of life and material damage. For instance, the storm surges accompanying the 1970 and 1991 tropical cyclones devastated Bangladesh and claimed about half-a-million lives. Bangladesh, in fact, suffered the greatest loss of life in its disaster-prone history in the cyclone of April 1991.

Some countries rarely experience the direct effects of tropical cyclones, but when they do, they usually have to bear with very high levels of destruction in terms of lives and property. Sri Lanka is one such country. In other countries, the effects of tropical cyclones or depressions are more frequently felt in the form of heavy rainfall (such as in Pakistan) or very strong winds (such as in the Maldives).

One tropical depression in Pakistan in 1993 resulted in 600 deaths and the loss of hundreds of fishing boats. In May 1999, another deadly cyclone caused large-scale devastation in the districts of Thatta and Badin in the southern province of Sindh. The cyclone - called

'Hurrican Thuth' - travelling at a speed of 273 km per hour, battered the two districts for around 36 hours, destroying aound 50,000 houses. Across the international boundary, though the cyclone brushed past the Indian state of Gujarat, it claimed more than 300 lives.

Development and Distribution

Tropical cyclones are seasonal phenomena and occur with maximum frequency in the months of March-May and October-November. But in north Indian Ocean - the Bay of Bengal and the Arabian Sea - their frequency shows a bimodal maxima peaking once from mid-April to mid-June and again from October to mid-December. The countries in South Asia face cyclonic activities due to lows and depressions that develop over the north Indian Ocean. Although only about 6 per cent of the global tropical cyclones occur in this part of the ocean, they are the deadliest in the world. The average number of storms in the south Indian Ocean as computed by Holland (1993) is 10.4 per year respectively.

The Bangladesh coast:

This coast in Bangladesh has been divided into four areas - Khulna/Sunderban coast, Barisal/Patuakhali-Noakhali coast, Noakhali-Chittagong coast and Chittagong-Cox's Bazaar coast.

Storm surges associated with tropical cyclones that form over the Bay of Bengal affect almost all parts of the Bangladesh coast and the eastern coast of India. The most significant and frequent occurrences, however, have been in north Bay of Bengal causing terrible destruction of life and property. These storm surges in north Bay of Bengal are due to the combined effects of the storm tide and astronomical tide, the shallow bathymetric configuration and the funnelling shape of the Bay of Bengal.

Historical records show that the Noakhali-Chittagong coast and the Barisal/Patuakhali-Noakhali coasts are much more vulnerable to storm surges, having a maximum storm surge height of 13.64 metre.

The Great Backerganj cyclone of November 1, 1876, the Killer Cyclone of November 12, 1970 and the Worst Killer Cyclone of April 29, 1991 are the three most devastating cyclones in Bangladesh - perhaps historic in the world in terms of intensity and the havoc they wreaked.

The Orissa Super-cyclone: Anatomy of Destruction

The super-cyclone of Orissa (October 1999), the severest of the century, left a permanent environmental impact on the coastal ecology of the region. The damage was extensive because a tidal surge lashed the coast and swept inland up to a distance of 15-25 km. Besides the loss of human lives, crops were destroyed and vast tracts of saline-inundated agricultural land was rendered unfit for cultivation. According to eyewitnesses, the affected districts lost more than 90 per cent of their tree cover.

Mangrove forests and sand dunes on the coastal belt act as natural barriers against cyclones and tidal surges. Depletion of Orissa's coastal mangroves aided the super-cyclone. Earlier, long stretches of mangrove had thrived along the state's coastline. But human interference had reduced their numbers. People from neighbouring states had been infiltrating in these areas and cutting down trees to make way for agriculture. Thousands of hectares of mangrove forests were also cleared during the construction of Paradip port. The continuing proliferation of prawn culture in the region posed another serious threat. According to the *State of Orissa's Environment Report*, mangrove swamps in the state have been receding at a rate of 3 km a year. If the destruction of these forests continue, the remaining natural barrier against tidal surges and cyclones will be lost forever.

The biggest casualty of the super-cyclone has been the Chilka Lake in Khurda district of the state. Due to its critical location, the Chilka is regarded as one of the most dynamic coastal environments in India and is considered an important indicator of the state of the region's environment. Already under threat from siltation due to large-scale deforestation in its catchment area, the loss of tree cover due to the cyclone could hasten Chilka's – which is Asia's largest brackish water lake - death. The Chilka Bachoo Andolan (Save Chilka Movement) estimates that about 3,00,000 cusecs of freshwater laden with 13 million metric tonnes of silt from rivers finds its way to the 1,150-sq. km. lake every year. This is a major cause of the lake's shrinkage and reduction in depth.

Source: Down To Earth, November 1999

The Indian coast:

Since India has a long coastline and its eastern and western coasts face different ocean basins, their vulnerability is being discussed separately. According to the World Meteorological Organization, India accounts for 6 per cent of the total number of cyclones world-wide.

The east coast: For ease of study, the eastern coast has been divided into the West Bengal, Orissa, Andhra Pradesh and Tamil Nadu coasts.

Historical records show that the West Bengal coast, with a storm surge height in the range of 11.81-12.12 meters, is the most vulnerable to storm surges. However, the death toll due to tropical cyclones on this coast is less compared to that in Bangladesh due to the coastal configuration and the bathymetry.

The west coast: The west coast has been divided into the Gujarat, Maharashtra, Karnataka and Kerala coasts.

The data on storm surges associated with cyclones that form over the Arabian Sea and cross the western coast of India is not available, except for a few cyclones. The Gujarat coast is the most vulnerable to storm surges with surge heights being about 1 to 6 meters.

The Pakistan coast:

Pakistan's coastal areas have been divided into the Mekran coast and the Sind coast. About eight cyclones have been reported here during the period 1891 through 1991.

The Sri Lankan coast:

The Sri Lankan coast is divided into the East, North, South and West coasts. Vulnerability analysis of the Sri Lankan coast is based on information on about 17 cyclones during 1845-1997.

Reports on human casualties in Sri Lanka are not available for all the cyclones, except the great cyclone of 1978 which killed 915 people and the cyclonic storm of November 1992, which also killed many people. Though the catastrophic nature of the cyclones depend on various factors such as coastal configuration, landfall area, and the high tide and low tide conditions, reduction in human casualties depends mainly on the early issuance of forecasts and storm warnings by the National Meteorological Services and the effective use of early warning apparatus by disaster management systems of different agencies and authorities. Latest developments in science and technology have greatly enhanced the accuracy of cyclone tracking and forecasting techniques, in addition to improving timely dissemination of warning messages.

Operational Cyclone Forecasting Organisations

An efficient cyclone warning system is required to provide the following information:

- Accurate and detailed forecasts of adverse weather conditions sufficiently in advance.
- Rapid and dependable dissemination of the forecasts, advisories and warnings to the concerned agencies.
- Sufficient lead time to enable the threatened population to take appropriate protective measures.

Though there are broad similarities in cyclone warning systems around the globe, certain regional differences do exist. The cyclone forecasting system in India is a three-tiered structure that caters to the needs of its maritime states. Area Cyclone Warning Centres (ACWCs) and Cyclone Warning Centres (CWCs) issue warnings to the Chief Secretaries, the Relief Commissioners and Coastal District Collectors of the maritime states; these warnings are in the form of basic information related to cyclone distress prevention and mitigation. These are issued under a two-stage warning scheme whenever any coastal belt is expected to experience heavy rain, gales or tidal waves associated with cyclonic storms. The first stage, known as 'Cyclonic Alert', is issued 48 hours in advance of the expected commencement of adverse weather over the coastal area. The second stage, known as 'Cyclone Warning', is issued 24 hours in advance.

This cyclone warning activity is supported by an observational network which consists of the national synoptic surface network, the upper air network, observations from Voluntary Observing Fleets (VOFs), observations from Cyclone Detecting Radars and data from geostationary and polar orbiting satellites.

Some of the other important bulletins and warnings issued by Cyclone Warning Centres in India are:

- Weather and sea bulletins for
  - shipping on the high seas
  - ships plying in coastal waters
- Port warnings
- Fisheries warnings
- Bulletins for All India Radio
- Album page warnings

Tropical cyclone advisories are also issued by the Regional Specialised Meteorological Centres (RSMCs) to all the member countries of the WMO/ESCAP Panel on Tropical Cyclones during the cyclone period at regular six-hourly intervals. Besides this, a tropical weather outlook for north Indian Ocean is issued daily at 0600 UTC as a routine to the member countries of the panel.

2.4 Earthquakes

Between 50 to 60 per cent of India is vulnerable to seismic activities of varying intensity. The Himalayan range, the Indo-Gangetic plains and the Kutch and Kathiawar regions of western India are geologically

the most unstable parts, and are most prone to earthquakes. Areas in and around the Union Territory of the Andaman and Nicobar Islands are also quake-prone, although earthquakes occasionally occur elsewhere in India too. For instance, the September 1993 earthquake that struck the Maharashtra state in central west India, claimed nearly 12,000 lives.

The Himalayan frontal arc, flanked by the Chaman fault in the west, constitutes one of the most seismically active intra-continental regions in the world. In a span of 53 years, four earthquakes, exceeding magnitude 8 on the Richter scale, have shaken this region. These are the Assam earthquakes of 1897 and 1950, the Kangra earthquake of 1905 and the Bihar-Nepal earthquake of 1935. Nepal's entire territory lies in the region of seismic activity, which regularly experiences earthquakes with magnitudes of 5-8.

2.5 Landslides

Incidence of landslides is very common in the hills and mountainous regions of South Asia. Topography alone could be the primary cause; however, in most cases, landslides are aggravated by human activities such as deforestation, cultivation and construction which destabilise the already fragile slopes. For instance, as a result of combined actions of natural and man-made factors, as many as 12,000 landslides occur in Nepal every year. In 1998, floods and landslides in Nepal killed about 273 people and the country suffered a loss of about US $28,854,000 (*SOE Report 2000: Nepal*).

2.6 Forest Fires

In many countries, vegetation, forests, savannahs and agricultural crops are burnt down to clear land and change its use. Forest clearing accelerates as populations expand and pressures to exploit natural resources increase. Much of the expansion into forested areas uses the cheapest form of cover removal: fire. Increased pressure for development has led to much of the recent fire damage in tropical rain forests as loggers, cattle farmers and peasants take advantage of the dry season to clear land for farming.

The health impacts of forest fires can be serious and widespread. Forest fires can have a potential impact on global atmospheric problems, including climate change. Researchers have also realised the signiicant contributions of biomass burning to the global budgets of carbondioxide, methane, nitric oxide, tropospheric ozone, methyl chloride and elemental carbon particulates. The extent of biomass burning has increased significantly over the past 100 years. It is now recognised as a significant global source of atmospheric emissions, contributing more than half of all the carbon released into the atmosphere.

India: Case for a National Seismic Policy

A devastating earthquake shook Chamoli region in Uttar Pradesh on March 29. The quake, measuring 6.8 on the Richter scale and lasting around 40 seconds, is said to have been the most powerful in the region during the last hundred years. It reduced thousands of houses to rubble. This tragedy has served to remind us of the need for a scientific study of seismic activities and a comprehensive disaster management policy. Though India is one of the four most quake-prone areas of the world, it does not have a seismology policy or a specialised institute to study seismic activities.

2.7 Industrial Disasters

Industrial accidents and disasters are not only the cause of a large number of casualties. They are also the source of prolonged physical and psychological trauma for those who are exposed to toxic agents or those who, without being injured, lose all their belongings and often their jobs and need to be resettled in unfamiliar, sometimes inhospitable and often inadequate circumstances.

Our memory is still fresh about disasters such as Union Carbide in India and Chernobyl in Russia. At Chernobyl, radioactive material leaked from one of the nuclear station's reactors, resulting in one of the largest

Flood is a recurring phenomena
Source: Bangladesh:State of the Environment 2001

accidental contamination problems in the world, with profound impacts on environment and health, forcing the evacuation of a quarter of a million people who have not yet returned to their homes eight years after the event.

Some of the precautions that can be taken before establishing an industry to prevent accidents are the following:

- Industries should be located away from human settlements. Wind direction too should be taken into consideration to minimise the spread of a possible disaster to distant places.
- The staff should be adequately trained and updated not only in routine operational safety, but also in response to emergencies, and compliance with safety standards should be regularly monitored.
- Emergency preparedness plans at all appropriate levels and early warning systems should be developed and tested at regular intervals (in line with various international guidelines such as those of the UN/ILO/WHO/UNEP).

2.8 Cultural and Ethnic Conflicts/Wars

These are also major causes of man-made, but avoidable, destruction.

Responses

The level of disaster preparedness is a major factor in mitigation of natural disasters. There is a need for dissemination of information on the measures to be taken before, during and after any disaster.

Forest Fires in India

The forest fires of May 1999 claimed many lives and destroyed property worth crores in India. The worst affected areas were Tehri, Garhwal, Almora and Pithoragarh in UP; Kangra, Hamirpur, Bilaspur, Solan and Sirmaur in Himachal Pradesh; the Bihar plateau; and Mount Abu and the sourrounding areas in Rajasthan. The fires that kept burning for over a month, charred 80,000 hectares of forests, destroying pine, oak and deodar trees and much of the wildlife in Uttar Pradesh. In Himachal Pradesh, there were reports of fires in almost 38 forests. About 12,000 hectares of forests and plantations were reduced to ashes. Thousands of hectares of forests were charred in the hills of Uttarakhand too. Forest fires destroyed more than 40,000 hectares out of the 3,336,655-hectare forests in the region, mainly affecting pine trees.

Forecasting

Technologies such as space sciences (SS), remote sensing (RS) and geographical information system (GIS) have wide applications in natural resources management, development planning, environment studies and disaster monitoring purposes. Even if many natural disasters cannot be averted, their impact can be reduced through timely warning and evacuation measures. Space-borne techniques play a significant role here.

There is a need to incorporate geological data in both long- and short-term planning to avert or reduce the impact of natural disasters. This will have to be done on a country-specific basis, as some countries of the region will still need to build or strengthen institutional capabilities to collect relevant geodata. Others may want to concentrate more on staff training to improve interpretation and/or presentation skills; there may also be some who have to focus more on organisational and managerial issues to ensure that crucial information reaches the authorities and is acted upon.

Proper long-term land use planning by incorporating all geology-related data available, would help identify and allocate hazard-free areas for industrial and urban development. This could then be by far the most effective way of dealing with seismic disasters, with high gain at relatively low costs. Introduction of legal enforcement of property insurance against damage inflicted by natural, particularly seismic, events may be considered as one of the most efficient ways to ensure that building codes are followed and properly allocated according to realistic criteria based on actual geological conditions.

Use of Best Available Technology

Regional and national programmes on monitoring through satellite-based remote sensing and multi-level environment protection systems at regional/country/area level are needed.

Greater emphasis should be placed on expanding observational and monitoring systems, especially in areas/regions where data is scarce. There is still a need to establish and upgrade observational equipment and networks to monitor hazards properly and disseminate warnings quickly through an efficient warning system. To help improve them, reliable feedback information should be collected on warning performance, public responses and damage caused by natural disasters.

Existing seismic data acquisition networks in the countries vulnerable to earthquakes should be updated and improved. Certain areas in the region still lack

seismic data acquisition systems. The physical impacts of natural hazards can be reduced by preventing or modifying the occurrence of the hazard, such as in the case of flooding. This can be done very effectively through land-use planning and management, particularly in areas where structural measures would be too difficult or too expensive to implement.

Scientific and Mutual Cooperation

The seismicity of the region needs to be better understood. There is need for free exchange of data among countries in the region in standardised formats. Attempts should also be made to utilise the available data more effectively. Since urban areas are potentially more vulnerable to hazards such as earthquakes, there is need for (micro) zonation maps delineating earthquake hazard levels.

Some degree of regional cooperation in disaster prevention and mitigation, particularly among neighbouring countries, is already gaining ground. The Panel on Tropical Cyclones has been established to fight the growing incidence of cyclones in the region. It includes Pakistan, India, Bangladesh, Sri Lanka and Maldives among the South Asian countries. Moreover, the developing countries of the Asian region are increasingly being assisted in their efforts by bilateral donors, UN organisations and multilateral agencies, such as the Asian Development Bank and the World Bank.

Institutional Development

Many countries of the region (Bangladesh, Malaysia, Nepal, Sri Lanka and Maldives) have appointed national Inter-disciplinary Committees for Natural Disaster Reduction (IDNDR) to coordinate disaster mitigation activities of government and other agencies. These committees are also involved in:

- collaborating with all the concerned departments and institutions to formulate and implement plans and programmes.
- formulating measures for natural disaster prevention and mitigation.
- establishing programmes of cooperation with international organisations and non-governmental organisations.

In India, flood forecasting and early warning in disaster-prone areas is being considered as one of the most important and cost-effective measures for disaster relief. A Cabinet Committee on natural calamities has been constituted. The current Five Year Plan emphasises the extension of the existing forecasting network. Ten high power cyclone detection radars have been installed along the east and west coasts of the country, and there are plans for the extension of the cyclone warning systems to all vulnerable areas. Contour mapping of coastal areas is also being carried out to identify potentially vulnerable areas, and India is also making efforts to minimise flood-related crop losses by contingency planning. In addition, a new drought forecasting technique, utilising regional and global parameters physically related to the south-west monsoon, is now being used. This, together with grain provision, access to health facilities and protection of cattle, has enabled the country to significantly improve its drought management systems.

In Bangladesh, cyclone and flood warning systems are well developed and institutional arrangements for the management of disasters have improved over the past decade. However, despite all efforts to reduce losses, it is not possible to evacuate several million people living in coastal areas and offshore islands when disaster occurs. A Natural Disaster Prevention Council has been set up in the country. The Council has taken over the coordinating functions of the government plans and action in the fields of natural disaster forecasts, management and post-disaster relief and rehabilitation work. In Sri Lanka too, a cabinet sub-committee has been appointed to examine floods, cyclones, landslides and soil erosion.

Awareness

Community awareness through educational programmes on warning systems and other aspects of disaster preparedness also need to be developed and implemented. Communities comprising of representatives of NGOs and the public could be established at the local level to monitor and guide disaster preparedness and relief operations.

Mitigation Measures

Environmental enhancement measures play an important role in combating natural disasters.

Programmes on rehabilitation of degraded lands and afforestation are being undertaken on a large scale. Implementation of comprehensive land use plans, primarily drives by environmental concerns, have been instrumental in incorporating hazard mitigation and preparedness provisions into the development process. For instance, provision of green belts on river banks reduces flood damage; parks and open spaces in a city can provide temporary shelters during earthquakes. Similarly, slum and squatter settlement improvement schemes that are being undertaken in many areas have also helped reduce the risk of disasters.

Hazard mapping and risk assessment needs to be done. This would delineate areas vulnerable to geology-related natural hazards and the frequency, intensity, impact, etc. of each hazard. There is need for comprehensive vulnerability analysis for disaster-prone areas. As a preventive measure, earthquake-resistant designs for dwellings have helped reduce the number of casualties and prevent serious damage to buildings. In most areas, however, there is still a need for preparation or review of earthquake-resistant design codes for buildings and other engineering structures and for their enforcement, as well as the undertaking of proper arrangements for the infrastructure to be able to deal with natural hazards and disasters.

In Bangladesh, the government has adopted a disaster policy which puts equal emphasis on pre-disaster planning and preparedness while retaining post-disaster relief and rehabilitation capabilities. Embankments are under construction in the coastal areas and on the banks of major rivers. India also has plans to promote flood-proof buildings, afforestation in flood-affected river basins and drainage system improvements.

In Nepal, the National Comprehensive Plan for Disaster Management was drafted in 1991, and its provisions have been used as guidelines for disaster management activities.

Sri Lanka has prepared a National Disaster Management Plan and a draft bill which provides for the preparation and implementation of counter-measures, including emergency preparedness and relief, and the creation of appropriate institutes to deal with disasters.

Non-structural disaster prevention and mitigation measures adopted to assist in minimising losses includes raising public awareness about disasters and training people to cope with them. Media, such as radio, newspaper and television, too have been useful.

Rescue Services and Health Relief

It is important that health facilities are located and constructed to withstand the effects of natural disasters, and are well equipped to provide basic assistance following emergencies of all kinds. Geology-related hazard zonation maps of appropriate scale would provide a good basis for deciding places that are relatively safe for the construction of emergency public health facilities.

The complete disruption of water and basic environmental sanitation services during a disaster is a major concern of the health sector. These hazards can be minimised if public health officials work closely with municipal workers to set up a response system that reduces the risk of water contamination and water and insect-borne diseases, and initiates safe disposal of solid wastes as part of routine preparedness planning.

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3.0 Industrial Pollution

The industrial sector is one of the most dynamic sectors of the economy and plays an essential role in economic development and the alleviation of poverty. If environmental considerations are not effectively integrated into the design of industrial processes, the implications can be manifold. Industries, in general, consume 37 per cent of the world's energy and emit 50 per cent of world's CO_2, 90 per cent of world's SO_2 and nearly all of its toxic chemicals. Lately, however, the severity of some of the local impacts of industry and the high cost of remediation industry is becoming an increasingly sensitive issue.

There has been a region-wide structural shift towards increased industrialisation. Developing economies with low levels of industrialisation are gradually shifting their dependence from agriculture to the industrial sector, while developed economies, with a high level of industrialisation, are shifting from the industrial to the service sector. Industry has increased its share of total output from 21 to 26 per cent in South Asia and this structural shift is expected to continue into the future. This shift has given rise to concern towards increasing carbon intensity in both local and regional environment. The CO_2 emission (GHG) by industries in South Asia was estimated to be about 437 million tonnes in 2000-end and is estimated to increase by another 85 per cent by the year 2010.

Current efforts for global environmental protection are mainly being concentrated around large-and small-scale development projects. But a large number of small-scale operations have been left un-noticed inspite of their high resource intensity, inefficiency and high level of pollution load per every unit of production.

3.1 Large-scale Industries – Demand Driven

South Asia has seen 5.6 per cent industrial growth, which has quadrupled in the last 30 years. A substantial share of large-scale industrial growth in South Asian countries revolves around the transformation of raw materials into industrial products such as steel, paper, and chemicals. The production of industrial chemicals has been shifting to the developing world (mostly South Asian countries). In 1990, this industry's annual rate of growth was 5.6 per cent in the developing countries, compared with a mere 1 per cent in the developed world.

The processes involved in these industries - which also include other sectors such as electricity generation, petroleum refining, mining, paper production, and leather tanning - are resource-intensive, and tend to produce a disproportionately large amount of hazaradous and toxic wastes.

High Demand of Products - Increased Pollution Load

In recent years, the demand for certain types of consumer products which have led to the development of industrial growth, has been particularly high. For instance, the automobile sector growth in the last five years has been rapid (especially in India, Pakistan and Nepal). This growth alone has contributed to 4 per cent of the large-scale industrial pollution and 20 per cent of the small and medium enterprises (SMEs) pollution load.

Environmental Impact of Large Industries

Industries such as cement, glass, ceramic, iron and steel, paper and pulp, refineries, etc, exercise a wide range of environmental impacts. They emit large amounts of nitrogen, sulphur and carbon oxides into the air. Emissions of lead, arsenic and chromium, both from glass and iron and steel industries, are extremely toxic. Waste disposal from such industries causes extensive water and soil contamination too. Extraction of raw materials causes large-scale surface disturbance and erosion.

3.2 Characteristics of Population-Environment Relationships in Industrialised Regions

The spatial distribution of population, particularly the concentration of population and labour resources in urban areas, is a key requirement for industrial development. Industrial activity and the pull of higher urban wages, in turn, encourage further in-migration to cities. Higher population concentration or 'density' in cities may allow the widespread provision of basic services, especially schools and health facilities, higher

standards of living, and better environmental conditions. At the same time, high urban population density and the consumption patterns of a rapidly growing urban populace creates various physical environmental problems with, for example, waste disposal and vehicular emissions. Industrial activity also directly transforms the environment through the production of industrial wastes leading to problems of water, soil and air pollution. An environment polluted by industrial activities, in turn, adversely affects the population's health.

These reciprocal relationships between industrial, population and environmental trends may vary according to the temporal and geographic scale at which they occur. Concurrent long-term global trends of increased population growth, population concentration, consumption and industrial activity are believed to play some role in global environmental changes such as acid rain, ozone depletion and global warming. The overwhelming majority of impacts between population, environment and industry, however, occur at the local level. Coastal areas, which are frequently the setting for urban development, are inherently subject to natural transformations such as sea-level rise or erosion. Population or industrial activity may both affect and be affected by these natural processes. For example, in the coastal areas of the Maldives, a rise in sea-levels - possibly related to global warming and continued development - has led to increased flooding which threatens the ever-increasing coastal population.

Although industrial pollution may emanate from a localised source, its impacts may extend across geographic and administrative boundaries. Moreover, several resources (water, air and soil) or several distinct population groups may be affected at the same time. Distinction may be made between endemic long-term deterioration and short-term disaster situations, for example due to industrial accidents or natural calamities. However, it is often difficult to classify the time frame of population, environment and industrial relationships since effects are often lagged. For example, the impact of industrial pollution on populations or the environment may not be apparent until several decades after it occurs. A need, therefore, exists for determining 'situations' as opposed to sites. Analysis of impacts may need to go beyond geographic and administrative boundaries to consider wider interactive, productive, ecological and demographic 'systems'. In addition, both long- and short-term impacts should be considered.

3.3 Impacts of Industrial Restructuring

Urban growth, increased standards of living and declines in family size and mortality go hand in hand with industrialisation. Industries and populations in South Asia traditionally grew up around local resources and heavy industries, such as coal, iron, steel and shipbuilding. Due to rapid technological change in recent years, demands for these products have declined and many countries have undergone a common transition away from heavier industries based on raw materials to lighter consumer (plastics, fibre and communications) and service industries. Meanwhile, all countries have become more and more interdependent as greater 'economic globalisation' occurs. This overall sequence of events has been termed 'de-industrialisation' although the more appropriate term may be 're-structuralisation', since industrial activity in many instances has changed rather than declined altogether.

Risk Management and Responsibility

If short- or long-term negative impacts occur, governments and industry should be ready to assume responsibility for population and environmental outcomes. Affected populations should also have a means of actively making claims and pursuing compensation. Since the impacts of cumulative industrial pollution and even short-term disasters may have a lagged effect on population and the environment, governments, industry and affected populations should take into account both long- and short-term consequences. In short, what is called for is the creation of a 'new societal disposition' where government, industry and affected populations share a sense of mutual responsibility to the environment and to each other.

Of the total export from the South Asian countries, a major portion is contributed by small-scale industries, which also contribute 50 per cent of the total industrial pollution. Large-scale industries (for industrial statistics, see *Table 24*) are becoming increasingly concerned about achieving and demonstrating sound environmental conservation performance on account of growing compulsions from stringent environmental legislation. Apart from these regulations, there is now an expanding tool kit of innovative and flexible incentives which can be used to get polluters to clean up their act. These are the voluntary initiatives such as cleaner production, environment management systems, etc. SMEs form the most uncontrolled and unorganised sector which, due to lack of awareness, have not managed to adopt these initiatives.

Table 24 : Industrial Statistics - South Asian Region

	Bangladesh	Bhutan	India	Iran	Maldives	Nepal	Pakistan	Sri Lanka
Gross Domestic Product (GDP) in Billion US$) (1999)	44.30	0.4	437.7	238.6	0.4	4.9	61.6	15.7
Consumer Price Index (1990=100) (1999)	163.0	197.0	228.0	752.0	204.0	229.0	231.0	237.0
Manufacturing Value Added (MVA in Billion US$) (1999)	8.0	0.0	63.9	29.5	0.0	0.5	9.7	2.3
Constant MVA in Billion US$ (at 1990 Prices)	8.0	0.1	88.1	17.3	0.0	0.5	8.8	2.7
MVA per Capita in US$ (1999)	63.0	22.0	65.0	448.0	89.0	20.0	64.0	125.0
Share of MVA in GDP in % (1999)	18.0	11.1	14.6	15.7	6.5	9.4	15.8	14.9
Manufactured Exports Million US$ (1998)	4,648.0	37.0	23,739.0	-	32.0	246.0	8,375.0	3,928.0
Share of Manufactures in Total Exports in % (1998)	91.90	55.5	71.7	-	36.1	90.8	95.1	87.9
Manufactured Imports in Million US$ (1998)	6,258.0	77.0	2,37,228.0	-	323.0	490.0	8,757.0	4,596.0
Share of Manufactures in Total Imports in % (1998)	89.20	84.3	62.6	-	92.6	73.3	84.0	86.5

Source: www.ilo.org

India: The Bhopal Disaster

In 1984, a major leak of toxic chemical gases occurred from the Union Carbide chemical plant in the city of Bhopal, India (with a population of 2,00,000) due to a combined lack of safety monitoring and enforcement by both the government and the company. A total of 3,20,000 people in Bhopal and its surrounding towns were exposed to toxic gas, as many as 10,000 died immediately and an estimated 1,00,000 persons continue to suffer from chronic eye, respiratory, gastrointestinal and psychiatric illnesses and cannot live or work normally. The environment and economy in Bhopal has also suffered due to water, soil, food and livestock contamination. The poorest population living in the slums around the Union Carbide plant suffered the brunt of these impacts.

The Indian government sought legal compensation from Union Carbide in the United States and received a sum of $470 million, an amount which may be inadequate to cover the long-term health, economic and human impacts caused by the disaster. Distribution of these funds has proved problematic due to the difficulty of establishing compensation criteria. Also, many in the affected population are incapable of making claims due to a lack of information on mental and physical illnesses related to the disaster. The Indian Council of Medical Research, UNICEF and an international medical commission undertook baseline surveys of victims immediately following the disaster. However, the existing hospital-based health system in the region is inadequate to carry out proper follow-up and treatment, which requires more extensive community-oriented services. Important issues such as the resettlement of population away from the plant area and the creation of employment opportunities for the affected and disabled population which now have disabilities, have yet to be addressed. The response by the government and Union Carbide has, therefore, been deemed inadequate and incomplete.

The Bhopal disaster underlines the problem governments confront in formulating a response to disaster situations when poverty levels are high and health infrastructures and government resources are severely limited. This brings into focus the need for private multinational (or public) industries to take some responsibility towards the environments and populations they are located in.

3.4 SMEs: An Uncontrolled and Unorganised Sector

The small-scale industry (SSI) sector plays an important role in the industrial development of a nation as well as of the region. In Asia, this sector contributes nearly 40 per cent of the total industrial output, besides having a 35 per cent share in direct exports. It also plays an important role in generation of gainful employment opportunities.

Small scale enterprise - zinc cyanide electroplating unit

The definition of 'small' and 'medium' enterprises (SMEs) differs from one country to another. SMEs have been defined against various criteria, such as the number of workers employed, the volume of output or sales, the value of assets employed and the use of energy. Other definitions are based on whether the owner works alongside the workers, the degree of sophistication in management and whether or not the enterprise lies in the 'formal' sector.

The SME sector is important for many reasons. It is a major employer, and one with reasonable equity benefits in terms of distribution of income. A strong SME sector is critical in terms of the goods and services it provides to large enterprises and to informal, micro-enterprises. In developed countries, informal micro-enterprises have been largely supplanted, and it is suggested that this pattern will also occur in more advanced developing countries. On the other hand, in the developed countries, large-scale enterprises are also increasingly downsizing and depending on networks of SMEs.

SMEs in India

- number about two million units
- employ two million people
- account for 60 per cent of exports
- account for 60 per cent of total production

Source: Development Alternatives

However, small-scale industries have a lot of adverse effects on the environment. Given their large numbers in developing countries, there is a growing need to address the problems of pollution, the efficiency of use of energy and raw materials, and the health and safety hazards these industries pose. Policymakers, thwarted by a lack of knowledge of the actual environmental impacts of small-scale producers, have only a limited understanding of how to balance employment creation within SMEs with environmental protection.

Compliance among the estimated six million small-scale industrial units in South Asian countries (defined in the region as any industry whose net worth is valued at less than US $2 million) is still extremely low, estimated at around 20-25 per cent. The majority of these units belongs to the 'unorganised sector' and is thus difficult to regulate. While several large, forward-thinking enterprises may go the distance in adopting integrated environmental management policies, most domestic industries are generally hard-pressed to go beyond basic compliance (foreign multinationals generally have stricter environmental standards).

Although there are regulatory bodies in all the South Asian countries, but these are not properly staffed or funded to complete their mission. With inadequate manpower, insufficient technical and financial resources and rampant corruption, effective implementation of state and national environmental legislation has yet to be achieved. In addition, there are loopholes in environmental regulations in all the South Asian countries.

For SMEs, the constraints on using environmentally-friendly technology are usually shortage of capital, limited access to technology, underdeveloped infrastructure, inadequate research and development, and the lack of awareness of the options for pollution control and prevention. Smaller industries have the added burden of using obsolete, inefficient production processes, which are typically more polluting. Such companies are often short of capital and skilled manpower and have limited access to information on pollution control and prevention systems.

Environmental Concerns in SMEs

The environmental costs of rapid industrial growth in South Asia can be divided into

- Contamination of water resources, including pollution of groundwater
- Unacceptable levels of air pollution, and
- Unsafe handling and disposal of toxic substances.

These costs are increasingly measured in terms of contaminated water, air and land; adverse health impacts; and damage to local fisheries and wildlife. Public health impacts (cancers, respiratory ailments, etc.) are now being found in and around industrial areas, particularly in the vicinity of heavy metallurgical, chemical and coal-fired industrial processing plants. These impacts are the direct result of using both dirty fuels (coal) in highly inefficient thermal processes (boilers, heating, cooking, etc.), and the manufacture and application of chemicals with inadequate treatment facilities.

Environmental impacts of SMEs in the developing world have generally been ignored. Although the promotion of such enterprises is seen increasingly as a way to provide employment and income, there is inadequate data available on their environmental impact and sustainability. It is often assumed that because they are small, these industries have little impact. Some of the specific environmental concerns associated with SMEs are discussed below.

An occupational health hazard - Lead battery plates being broken down by hand

Obsolete Technology and Unskilled Manpower

One of the main constraints for the development of SMEs is access to technology and management know-how. Whilst this partly reflects limited access to finance, there are additional dimensions. In South Asia, a combination of outdated equipment and a lack of market-oriented management knowledge and experience is a key constraint for the development of private sector SMEs, particularly with respect to their competitiveness in foreign markets. In this sense, it may be considered to be a factor encouraging the development of certain types of partnership arrangements between domestic SMEs and those in South Asian member countries - as one of the means for narrowing the knowledge and technology gap.

It is possible to distinguish two schools of thought on technology in enterprises: One that focuses on technological innovation and technology transfer (essentially, how the enterprise can get technological ideas that are new to it), and one that focuses on technological capabilities of the enterprise.

Small firms often have both low capital and low labour productivity. Capital productivity and total factor productivity peak in the medium size range of 5-500 workers in most industries; where firms can be ranked by the capital employed, the results tend to be rather more as expected (capital intensity and labour productivity rising, and capital productivity falling with size) but nevertheless, usually with such variance within size groups so as to make inter-group comparisons statistically insignificant.

Workers in SMEs

An overwhelming majority of the workers in SMEs are young, in the age group of 19-35 years (55.9 per cent in the small-sized and 55.6 per cent in the medium-sized enterprises). These enterprises are marked by a low child labour rate, the reason for which could be the lack of skills and physical strength required by some enterprises.

As far as the gender profile of the workforce in SMEs is concerned, there is a marked difference between the countries in the region. While women workers are employed by 4 per cent of the SMEs in Pakistan, they constitute 54 per cent of the workforce in Bangladesh.

Lack of Awareness and Training in SMEs

Around 11.0 per cent of the employed labour force of the South Asian countries works in the manufacturing sector. However, this figure may be misleading, as a large proportion of the labour force is migratory in nature, working in factories and at construction sites for some time and then returning home in the harvesting and sowing seasons. Most workers are, thus, not permanent and the turnover of workers in the SMEs is always high, which leads to poor management of work and the lack of skills prevailing among them.

A case that highlights the lack of awareness among the workforce in this sector is that of the chemicals industry. Out of the world-wide use of chemicals, around 80 per cent is consumed by the developed world and just about 20 per cent by developing countries. However, lately, the consumption in the developing countries has been on the increase. In terms of risks posed to the safety and health of workers and consumers and damage to the ecology, the South Asian countries are faced with more severe and complex problems due to a general lack of awareness about the potential hazards of chemicals, and the lack of adequate mechanisms for the protection of workers and the public from chemical hazards.

Use of Chemicals by SMEs in South Asia

Most developing countries require a considerable amount of chemicals for their agricultural, industrial and other needs. The economies of most of these countries are based on agriculture, therefore a sizeable amount of agrochemicals are required every year. While evaluating the risks posed by the use of chemicals, account should be taken not only of the volumes of specific chemicals consumed by a country, but also of the actual conditions under which these chemicals are used. For example, large fertiliser and petrochemical manufacturing plants may consume huge quantities of chemicals, but the actual exposure to the workers may not be very high, considering the nature of the processes. Although chemical substances may seem insignificant in terms of tonnage, workers can manifest serious exposure patterns due to inadequate protection and unsafe work practices. Some of the toxic chemicals used by SMEs in South Asia are given in *Table 25*.

Use of Hazardous and Toxic Chemicals

As discussed earlier, it is a known fact that SMEs are unorganised and uncontrolled. Most chemicals used by them are hazardous in nature. Some of the adverse effects due to the use of these chemicals are discussed below.

Health complaints in SMEs:

The study surveyed workers' opinion concerning the effect of exposure to chemicals on their health. While one-third of SMEs did not mention any specific problems, the rest complained of a number of ailments afflicting their workers such as headaches, and respiratory and skin problems.

Use of imported hazardous wastes from industrialised countries:

The motivation for exporting hazardous wastes to developing countries is primarily economic. As industrialised countries have become aware of the dangers of unsound disposal of hazardous wastes, more stringent environmental and safety measures have been introduced. As a result, disposal has become extremely costly. Developing countries provide a disposal option at prices that are often a mere fraction of the equivalent cost in the state of origin. According to one study in the late 1980s, the average disposal costs for one tonne of hazardous wastes in Africa was between US $2.50-$50.0, while costs in industrialised countries ranged from US $100-$2,000. The lower costs generally reflect the lack of environmental standards, less stringent laws and absence of public opposition due to lack of information concerning the dangers involved. Consequently, without regulation, developing countries will be increasingly vulnerable, since "like water running downhill, hazardous wastes invariably will be disposed of along the path of least resistance and least expense".

Trans-boundary movement of hazardous wastes is emerging as a critical issue, which countries in this region have not been able to address fully. Although seven out of nine countries in South Asia have signed the Basel Convention, the region lacks a common approach to the import of hazardous wastes. In Bhutan, where cheap labour and power are available, recycling is emerging as an important economic activity. The same is true of other countries, the most dramatic being the ship-breaking industry in the coastal regions of India and Pakistan. The impact of these trends in the context of trans-boundary issues is as yet uncertain, but it is clear that the institutional and regulatory capacities of the countries in this region for surveillance of import of hazardous wastes is limited and not addressed cooperatively.

The new target of international waste traders South Asia:

Times are tough for international waste brokers. In 1986, only three countries prohibited waste imports; today, the number has risen to 101. Realising the

Table 25 : Health Complaints as Reported by Workers in SMEs

Complaint	Industry/ Process	Chemicals used
Headache, skin problems,	Auto repair (denting and painting)	Calcium carbide, paint (nitro-cellulose based), body filler (mixture of metal oxides and resins)
Headache, respiratory, skin and eye problems	Laundries	Calcium hypochlorite
Headache and skin problems	Furniture Screen printing Tannery	Glue (formaldehyde & casein) Benzene, chromic acid
Skin burns, scalds	Carpet washing Wool Dyeing	Sodium hydroxide/hypochlo rite, Acetic acid, sulphuric acid
Eye problems	Positive and plate making (for printing presses)	Inkote, polychrome, eurogum, integran,
Headache, respiratory and skin problems	Paint manufacture	Titanium dioxide, zinc oxide, methylene chloride
Respiratory problems	Chipboard manufacture Polyurethane foam manufacture polyethylene glycol	Formaldehyde, urea, ammonia Toluene diisocyanate,
Skin, respiratory problems	Fibreglass manufacture Pesticide packing Surgical instruments manufacture	Styrene, methyl ethyl ketone Megamidophos, cypermethrin Trichloroethylene, chromium sulphate
Burn, scalds, irritation	Soap and allied products manufacture	Sodium carbonate, sodium nitrate, sodium hypochlorite

Source: www. ilo.org

inevitable end to easy dumping in South-east Asia, the waste dumpers are again shifting to areas less familiar with their practices, and thus, less likely to resist. While most of Asia has been receiving increasing amounts of waste during the past few years, it seems there is one region that the international waste traders have just discovered: South Asia. The countries in the region that are most vulnerable in this respect are Bangladesh, India and Pakistan.

Bangladesh: In an apparently new contract, a British waste trader sent seven tonnes of tin waste to Bangladesh in April 1993. In January 1993 alone, the United States shipped 16.5 tonnes of plastic waste to Bangladesh. In September 1993, Bangladesh newspapers reported that a New York City company, Solar International Trading Corporation, is proposing the development of an industrial zone, based on the use of imported waste. The plan envisages the import of 12,000 tonnes of waste daily, or 4.38 million tonnes annually, from the United States. Solar International says that some of the waste would be 'recycled' and some burned in a waste-to-energy incinerator.

In late 1991, four US corporations - Gaston Copper Recycling, Hy-Tex Marketing, Stoller Chemical and Southwire - all based in South Carolina, secretly mixed 1,000 tonnes of hazardous wastes, containing high levels of lead and cadmium, into a shipment of fertiliser which the Bangladesh government purchased using funds from the Asian Development Bank. Before the scandal broke, one-third of the toxic fertiliser had already been applied on farms, largely by children with no protective gear (*see 'Poison Fields', Multinational Monitor, April 1993).*

Textile Dyeing SMEs in Bangladesh

The major problem afflicting local environment around Bangladesh's textile dyeing industries is the hazards caused by dye effluents, which contain both chemical and organic pollutants. These can be highly toxic. Research has, for the first time, provided empirical evidence that the volume of such effluents from small-scale industries in the Third World often exceeds acceptable standards. Though the volume of effluents from individual small-scale dyers might be small (up to 8 cubic metres per day), the concentration of pollutants is generally high. The impact is significant where several producers are located at one place and discharge effluents into the same body of water. Large-scale dyers on the other hand generate greater volumes of effluent (70-400 cubic metres per day), but show a lower pollutant content per cubic metre of water.

This is also true of the other South Asian countries. Wastewater streams in the region contain suspended solids, oils, waste acids, chromium salts, phosphates, ammonia, cyanides, phenols, chlorides, fluorides, suflides, and heavy metals. Contaminated gas water, quench water and condensate are in many cases being discharged without treatment. The cooling water needs of 585 m^3 are partly recycled through cooling towers. This mitigates some of the thermal pollution caused when warm condensate is otherwise dumped into nearby rivers.

India: In 1992, India received 9,915 tonnes of non-ferrous metal wastes, including ashes and residues, copper, aluminium, zinc and tin waste and scrap from the United Kingdom. Through the month of August, the United Kingdom sent 328 tonnes of ashes and residues, 637 tonnes of aluminium waste and scrap, 79 tonnes of copper waste and scrap, 119 tonnes of nickel waste, 234 tonnes of tin waste and scrap, 1,586 tonnes of zinc waste and scrap and 501 tonnes of lead waste and scrap to India.

Although recent information regarding German waste exports to South Asia is not available, Greenpeace Germany has found that 48,47,000 tonne of metal waste and scrap were shipped from Germany to India in 1989. In 1992, Australia shipped 1,325 tonnes of tin waste and 33,621 tonnes of brass waste to India. In 1992, Canadian waste traders shipped 1,06,005 tonnes of iron waste, 79 tonnes of zinc waste, 392 tonnes of ash and residue containing mainly zinc, 19 tonnes of polystyrene waste and 23 tonnes of other plastic waste to India.

In addition, Canadian waste brokers shipped about 1,000 tonnes of lead waste to India in 1992. The dangers of lead are well known and have caused it to become one of the most strictly regulated wastes in the industrialised countries. Lead interferes with children's mental development, causes headaches, stomach problems, memory problems, anaemia, miscarriages and brain and kidney damage.

In January 1993, the United States sent 1,198.5 tonnes of plastic waste to India. Greenpeace recently uncovered a mysterious series of waste shipments from the United States to India. According to US Customs data, the cases have been found of exporting plastic waste from California to Chennai and Mumbai. In 1992, it shipped over 7,000 tonnes of plastic scrap to India.

Leather Tanning Industry in India

The leather tanning industry in India is made up of a few large export-oriented units and a large number of manual, small-scale units producing mainly for the domestic market. These facilities are mostly rather primitive and do not meet the minimum discharge standards. Release of wastewater from them is seriously compromising groundwater quality, and the problem is compounded by the discharge of heavy metals. Most of the small tanneries are concentrated in clusters which could facilitate common effluent treatment facilities after heavy metals and sulphides have been removed by pre-treatment. But toxic solid residues and sludge continue to be disposed without treatment, producing noxious gases which cause air pollution.

The tanneries cause water pollution problem as well with high BOD and COD values in their discharges, together with chromium, phenols, sulphides, ammonia, dyestuff, heavy metals, detergents and antiseptic agents. Average compliance with national discharge standards is estimated at a meagre 2 per cent. Even the largest tanneries remove less than 20 per cent of the required pollutants, and 435 tonnes (at least 36 times the standard) of highly toxic chromium compounds are discharged annually into rivers. Substantial amounts of solid waste — approximately 73 million tonnes a year — are also disposed of similarly.

Pakistan: In 1992, the US exported 1,865 tonnes of non-ferrous metal wastes, including copper, aluminium, lead, zinc and molybdenum waste and scrap, to Pakistan. In January 1993, the US shipped 19.5 tonnes of plastic waste to Pakistan. By August 1993, the UK sent a total of 1,949 tonnes of metal wastes to Pakistan – which was more than the previous year's total shipments. Canadian waste brokers shipped 290 tonnes of iron waste to Pakistan in 1992. Australian waste traders are also making inroads into Pakistan, exporting, for example, 21 tonnes of tin in 1992.

Toxic pollutants:

Toxic pollutants released from industry include heavy metals, cyanides and pesticides, and can be emitted into air, water or in solid wastes. Little is known about the quantities or precise sources of chemical and toxic residuals, since almost no government or industries do any sampling of toxic pollutants anywhere in South Asia (with some exceptions in India). However, their impacts are found in polluted groundwater, surface water, and urban and peri-urban refuse dumps.

Pollution Load per Unit Production

An expanding industrial sector affects the pollution load in two basic ways. The first is by increasing the total volume of pollutants in the short and medium terms. (In the long term, total pollutants may decline if dramatic shifts into cleaner industries take place, or if the share of the industrial sector itself falls. Neither is imminent). The second is by changing the pollution 'intensity' of industrial output, defined as the amount of pollution generated per unit of output. In South Asia, both the growth and the intensity effects are leading towards heavier pollution loads in the short and medium terms. No comprehensive data exists on either total pollution loads or pollution intensities in South Asia – which is a constraint to the full understanding of the extent and cost of the industrial pollution problem in the region.

Water pollution:

Industrial production and natural resource use and conversion often result in the creation of large amounts of water-borne pollutants. The major categories of water-borne pollutants are oxygen demand substances, measured by biological oxygen demand (BOD_5) and chemical oxygen demand (CODs); other standard industrial pollutants (such as total suspended solids), ammonia, phosphorous, sulphide, nitrate, sulphate, chloride, oil and grease; and polluting characteristics (such as pH.)

Air pollution:

The list of conventional air pollutants from industry includes SO_x, NO_x, Total Suspended Particulates (TSP), CO_2, CO and hydrocarbons (such as methane). Industrial air pollution is primarily derived from energy use. Industry consumes over 40 per cent of commercial energy in India and Bangladesh. Energy efficiency, therefore, is of utmost importance and it needs least-cost investments that industrial firms can easily make to reduce air pollution. Energy efficient technologies are implicit in most investment in 'clean technologies', which reduce pollution through reduced inputs and lower pollution intensities.

'Malé Declaration' on Air Pollution

Air pollution — in particular, emissions of sulphur dioxide and nitrogen oxides — is an emerging environmental issue in Asia. Rapid growth of cities, together with the expansion of industry and transportation, have made the Asian region increasingly concerned about these emissions. Projections indicate that potentially large increases in emissions may occur during the next 20-50 years if the current trend persists.

On March 19 and 20, 1998 senior government officials and experts on air pollution met at the Asian Institute of Technology, Bangkok, Thailand and agreed on a draft declaration. On April 22, 1998 the Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia was discussed and adopted by the Ministers of Environment at the seventh meeting of the Governing Council of South Asia Cooperative Environment Programme (SACEP), in Malé, the Republic of Maldives.

Limited Access to Information and Finance

Although SME owners in many countries often experience difficulties in accessing sufficient finance, the growth in business and political importance of the SME sector in South Asian countries is encouraging the development of deeper institutional support structures offering finance to SMEs, supplemented by an increasing mobility of capital.

At the same time, advances in technology and information systems management mean that traditional suppliers of capital (such as banks) have greater potential scope to 'downscale' and profitably manage smaller individual loan sizes, with implications for the service they can offer to smaller enterprises. In addition, as experience in some countries show, leasing companies, debt factoring organisations and other mechanisms are increasingly filling the remaining niches

in the SME financial support infrastructure. This is despite the fact that SMEs often need help in accessing sources of finance and certain types of firms still face major financial barriers.

Access to finance is a special problem for growth-oriented SMEs. In the more developed economies, there is a seamless chain of finance which allows firms to go from start-up micro-finance, to personal debt, to secured debt, to business angles, to venture capital, to IPO and public listing. However, the internationalisation of capital markets is not evenly spread, and the lower ends of debt and equity markets are not as internationally efficient as they might seem to be. This means that SMEs are often unable to realise their growth potential. On the other hand, India offers some interesting experiences in the role that its expatriates can play in supporting the emergence of a vibrant venture capital business to support new economy start-ups.

Incompetence in Global Markets

Compared to larger firms, SMEs have less ability to influence relationships with customers, suppliers and factor markets. As a result, their ability to survive and grow depends on their flexibility to respond to external environmental change forces. With a more limited internal resource base compared to larger firms (particularly with respect to management and financial resources), cooperation with other firms represents a potentially important strategic response.

While there may be several SMEs in one country, they are often undercapitalised and technologically weak, operating outside the formal sector of the economy. This needs to be rectified. Another crucial requirement for SMEs if they are to benefit from a global economy is access to new technologies.

Key Issues for Improving the Business Environment in SMEs

In certain basic respects, the elements of the business environment that are favourable to large-scale enterprise investment are also favourable to SMEs: e.g. political stability, macroeconomic stability, a predictable and transparent set of commercial laws and regulations and their impartial enforcement. That being said, SMEs may well gain more, for example, from macroeconomic stability, in so far as they are less likely to be able to hedge against foreign exchange risk. They are also likely to be the principal losers from a business environment rife with corruption and cosy business-government relations, and to suffer particularly from weak regulatory regimes in which payments from customers cannot be trusted. For many SMEs, the unpredictability of doing business with domestic and foreign firms seeking to invest, is perceived as a major barrier; it often manifests itself in corruption or in the form of lengthy, complex and opaque bureaucratic procedures. This in turn encourages business to make quick returns, rather than aiming for sustained growth.

Good reliable infrastructure, especially for communications and logistics, is essential for the growth of SMEs. The provision of infrastructure can be extremely expensive, notably in rural areas where the majority of the population still lives in developing economies, if not in transition economies. Traditionally, infrastructure investment has been contingent on foreign aid programmes, though private sector financing has become much more important in the past few decades and its importance is set to grow. This is especially so for telecommunications and electricity, where build-operate-transfer arrangements, boosted by utility deregulation in many countries, are now commonplace. New communication technologies are making it economical to provide telephone and Internet access even to more remote areas of trade.

In addition to finance, start-ups, even in OECD countries, require a range of affordable support services including office space and maintenance, telecommunications and computer facilities and managerial support (procuring permissions and licenses, accounting, marketing, etc.). Business incubators are one approach to outsouring some or all of these requirements, allowing entrepreneurs to share costly infrastructure and to concentrate on core competencies. Clearly, entrepreneurs need to be in control of key managerial functions, but for less critical ones economising on scarce human capital can be attractive.

Suggestions for Policy Action in SMEs

SMEs, being the engines of growth, have a responsibility in cooperating with the authorities and acting in partnership, particularly in developing environmental quality standards. They should ensure that their industrial activities do not conflict with the process of sustainable development. A harmonious balancing of these aims is important to achieve a healthy economic growth coupled with productivity improvement, and higher standards of living and equity with reduced pollution and protected life support systems. Some of the policy suggestions in this area are listed in *Table 26*.

It is a widely observed phenomenon that SMEs belonging to clusters and networks are often more competitive and innovative than those operating in isolation. Networks can allow accelerated learning

Table 26: Summary of Suggestions for Policy Action

Impediments	Suggested policy actions
Difficulty in accessing finance for R&D or other innovative efforts	- Reduce red tape in access to public R&D Programmes. - Provide more public funding at the national level to facilitate SME access to R&D. - Introduce tax incentives, such as pro-innovative investment tax credits and allowances. - Encourage co-operative agreements with government-paid R&D infrastructure (universities, research institute).
Lack of qualified personnel	- Foster links between universities and SMEs. - Liberalise the hiring of qualified foreign workers. - Enhance co-operation between schools, entrepreneurs and branch organisations. - Improve education, orienting it wards enterpreneurship. - Harmonise vocational training system with innovation and technological change.
Inadequate access to technological know-how	- Foster links between enterprises, research centres and laboratories. - Improve information networks on technological know-how. - Introduce tax incentives or tax relief for SMEs. - Promote the creation of joint ventures between SMEs to stimulate technology transfer.
High costs or complex procedures to register or defend patents	- Lower rate for patents and utility models for SMEs. - Reduce red tape! - Increase public funding for the protection and registration of patents. - Use all of the EU languages in patent registration.
Lack of information about potential co-operation partners	- Building of formal and informal information networks. - Creating a site on the Internet. - Developing of information systems and (local) advice services.
Lack of policy co-ordination between different public authorities.	- Government has to improve the existing instruments and procedures. - The government should co-ordinate goals and Programmes better. - One-Stop Shop!
Lengthy, complex and opaque bureaucratic procedures for registration, finance and permits, etc. -	- Create expert groups to investigate ways of reducing red tape and bureaucracy. - Simplification of procedures. Create one-stop shops - Create a single bureau for administrative procedures, next to the Chambers of Commerce.
Corruption among government officials	- Ensure that theyreceive appropriate salaries. - Promote the implementation of the OED guidelines on bribery and corruption. - Greater transparency at the decision-making level.
Developing of environmental standards	- Discharge standards need to be modified to load based standards thus allowing individual units to take up measures as per their production capacity. - Specified limits have to be fixed for unit production, and these should be based on easily verifiable and monitorable environmental targets. - Promotion of common effluent treatment plants among the clusters thus reducing the burden of individual treatments.

among firms. Furthermore, to innovate, entrepreneurs often need to reconfigure relationships with suppliers, which networks can facilitate. Over time, networks have come to encompass agreements with research bodies, educational and training institutions and public authorities. Examples of the diversity of clusters and networks might include regional clusters, firms in related lines of business that choose to locate and operate in close physical proximity. Nearly all countries have examples of the regional cluster. The use of cooperatives in agriculture and emerging industrial firms in developing countries aim at providing greater cohesion and market power to small firms.

3.5 Tourism - An Emerging Industry

The global tourism sector is evolving as well as growing. As incomes rise and transportation systems improve, intercontinental travel is increasing. In the past half century, tourism has been marked foremost due to its tremendous expansion. Between 1950-1999, the number of international arrivals to the current 664 million corresponding to an average annual growth rate of 7 per cent.

In addition to its strong overall expansion, the development of modern day tourism is also characterised by its ongoing geographical spread. In South Asia, with a rise in this industry from 8.0 per cent (1996-97) to 8.3 per cent (1998-99), the countries in this region have been successful not only in attracting significant numbers of tourists, but also in turning tourism into a source of wealth. India registered an increase in tourism by 5.2 per cent, Sri Lanka by 14.4 per cent, and Maldives by 8.6 per cent.

The Concept of Ecotourism

Over the last three decades, there has been a growing debate on the magnitude of the tourism industry in developing nations, and its enormous impacts and implications for the host regions. Due to tremendous growth and its adverse consequences, the concept of tourism has now changed from mass tourism to ecotourism/responsible tourism/nature-oriented tourism. Ecotourism, according to its definition, is "the symbiotic relationship between tourism and environment which benefits the socio-economic condition of local inhabitants and at the same time promotes tourism and protects the environment". By harboring environmental awareness both among local people and visitors, and by linking tourism to social and economic development, it is possible to conserve the natural and cultural heritage of an area, and to improve the living standards of host region inhabitants.

Ecotourism today is the largest growing sector with an estimated annual growth rate of 10-15 per cent. Nature tourists comprise 40-60 per cent of all international visitors (528 million). Their numbers thus amount to 211-317 million, contributing an international direct economic impact of US $166-250 billion. Twenty-40 per cent of these are wildlife-related tourists (106-211 million, contributing an international direct economic impact of US $83-166 billion). Ecotourism, if developed responsibly and managed properly, can become a powerful instrument/strategy for preservation of nature. It is an alternative form of tourism that promotes positive tourism-environment linkages, and at the same time, enables the host regions to take pride in what they have to offer for their people and the tourists.

Stress of Tourism - Urban Infrastructure and Natural Resources

The counterpart to the positive effects discussed in the box here is the negative impact which tourism can exercise on the physical environment. Tourism involves the actual movement and accomodation of people, often in large numbers, and is thus a major cause of transport development and urbanisation. Mass tourism necessitates the development of roads, hotels, restaurants, shopping and entertainment facilities and other services. In the process, the major tourist areas are inevitably transformed: at best, their natural

Table 27: Tourism -- South Asia

Years	No. of international tourist arrivals *(million)*	Market share	International tourist receipts *(million)*	Market share
1985	2.5	0.8	1.4	1.2
1990	3.2	0.7	2.0	0.8
1995	4.2	0.7	3.5	0.9
1997	4.8	0.8	4.0	0.9
1998	5.2	0.8	4.3	1.0
1999	5.7	0.9	-	-

Source: World Tourism Organisation

Growth in Ecotourism in South Asia

In developing its tourism sector, the Maldives has taken an approach of careful and flexible planning. This approach includes experimentation with different development techniques and the monitoring of these; staging of development; application of resort design and visitor use standards and controls; and maintaining of close coordination between the public and private sectors on tourism development and management. These initiatives have been very successful in achieving substantial economic benefits while still conserving the natural environment and cultural traditions. With respect to application of these tourism development approaches elsewhere, other small island areas such as the Lakshadweep (India) could learn from the experience of the Maldives.

Bhutan has adopted a policy of permitting a limited amount of tourism as well as emphasising high-value, special interest forms of tourism that generate the desired foreign exchange earnings as well as some employment and income. Bhutan also has a programme for regional staging of development, experiments with visitor controls to determine their most acceptable format, and environmental controls on facility development. The Bhutan model might have applications in other environmentally fragile mountain areas, where some concern exists about conserving the society's traditional cultural heritage, such as the other mountain regions in Asia. Tej Vir Singh, Director of the Centre for Tourism Research and Development in Lucknow, India, says that there is a great need for adoption of research-based sustainable tourism development policies, and implementation of these policies through application of stringent controls and coercive measures, in many mountain environments.

It should be recognised that in the case of both the Maldives and Bhutan, their approaches to sustainable tourism development have been successful in large measures because their governments can exercise considerable authority and are very centralised, and because each of these societies comprises highly homogeneous cultures with common religious values and lifestyles. In the Maldives, government ownership of uninhabited islands and its control over the islands' future land use are distinct advantages in guiding development patterns. Application of these models to other places will require adapting the implementation techniques to local situations.

In Sri Lanka, the scenic and cultural sites are situated mostly in the rural areas. Many of the rural poor use the forests and other ecosystems in an unsustainable manner for their livelihood. The government has decided to develop ecotourism, particularly in rural areas, as a tool for conservation and rural development. One of the three pilot projects in this sector is the 'Medirigiriya Community-based Ecotourism Programme', a local government community participatory project which integrates conservation with development.

In Iran, tourists express interest in seeing the encampments of nomadic tribes. This is because these settlements are the repositories of well-safeguarded traditions and culture of ancient Iranians.

Sources: Medirigiriya Community-based Ecotourism Programme in Sri Lanka – Integrating Conservation with Development by Chandra de Silva, Ecotourism Society of Sri Lanka (ESSL) and Sarath Kotagama, ESSL and Field Ornithology Group of Sri Lanka (FOGSL).

Sustainable Tourism development in the Maldives and Bhutan, by Edward Inskeep, UNEP Industry and Environment, July-December 1992.

Iran, State of the Environment Report, 2000.

attractiveness or innocence is lost as they become pampered and regulated tourist 'sites', capable of absorbing and 'processing' large numbers of visitors. At worst, major and often irreversible environmental damage is caused by a rush to build tourist facilities on the most attractive sites, by speculative land and building booms and by major inroads into the local ecology by the rapidly developing tourist infrastructure and services. Countless hotels, roads and other facilities provided for tourists ruin the pristine beauty of the sea coast, distrub the peace of the country and rob the mountains of their serene grandeur. In such cases, tourist development can be destructive.

The environmental problems connected with the development of tourism and recreation in mountain areas have been the subject of much discussion. The Himalayas, for instance, have always been a major tourist attraction. The number of trekking/ mountaineering tourists has increased, and their concentration in some specific areas has exerted immense pressure on the mountain forests for fuelwood and timber. Some other adverse impacts have been inadequate disposal of solid wastes and increasing contamination of drinking water.

There are also some adverse social and cultural influences. Inhabitants of historic cities and old villages are often distressed to find their narrow streets choked with tourist traffic and their picturesque squares and marketplaces turned into car parks for visitors. Recreational pressures of domestic tourists have resulted in erosion of dunes and heavy loss of coastal vegetation. Most seriously threatened, perhaps, are the fragile ecosytems of some of the islands in the Maldives. Tourism can add to the pollution of coastal waters, for example, through increasing sewage disposal from tourist resorts which have inadequate infrastructure, and through oil effluents from motor boats and cars.

Out of the total resources consumed by this sector, around 60 per cent is consumed by accomodation facilitating units such as hotels, resorts, guest houses etc. The hotel industry consumes a vast range of goods in construction and operation. They generally use huge amounts of energy, consume large amounts of water and generate disproportionate amounts of waste. Collectively, they employ thousands of people and welcome millions of guests through their doors. *Table 28* details the amount of solid waste generated by a typical 5-star hotel in South Asia.

Environmental Impacts of Tourism

The environmental impacts of tourism are not inevitable. Well-planned, well-designed and well-managed tourism can actually benefit conservation interests. An additional and financially justifiable reason for conservation and improved management is thus provided by the development of tourism. Indeed, tourism is one of the few resource-based industries that need not diminish or degrade the natural resources on which it depends. But that is the case only if tourism is managed properly, professionally, and with an effort towards sustainable development.

Table 28: Solid waste Generated in a Typical 5 Star Hotel in South Asia.

Type of waste	Avg. waste *(tons)* generated/month
Biodegradable organic waste	
Food Waste	102
Horticulture waste	25.5
Recyclable waste	
Metal Tins	1.8
Aluminium cans	5.2
Plastics	5.0
Newspaper	16.8
Card board	10.0
Glass bottels	48.0
Broken crockery	1.2

Source : Development Alternatives

The tourism sector is an important means of achieving socio-economic and physical development for South Asian countries. Its impact on the physical and socio-cultural environment is already substantial and widespread and can be expected to increase. The prime initiative must rest with governments, which are in the best position to appreciate the needs, interests and resources of international nature of tourism. This could take the form of cross-border collaboration between neighbouring governments where tourist resources cross national boundaries; collaboration would be on a regional scale, as in tackling South Asian pollution or wildelife management, and there would be efforts on a global scale to help governments in the search for a balance between tourism and the environment.

Responses

Government regulation is not the only solution towards controlling pollution. While there is no substitute for meaningful regulatory framework and information dissemination, much relies on persuasion, social pressure and market forces to help improve environmental performance.

Making Regulation more Flexible

The traditional approach to environmental regulation through permits, consents, monitoring and enforcement has often been slow, contentious and costly. As a result, developing countries are trying two new approaches to more effective pollution regulation.

The first is to more proactively prevent pollution, rather than focusing on treatment and clean-up. There will always be a need for regulation, quality standards and clearly defined limits with respect to certain discharges, but this proactive approach shifts the emphasis to improvements in process and management to reduce the volumes of pollution generated.

The second approach is to establish a careful balance between central standards and locally negotiated environmental requirements. Uniform national standards have the advantage of being clear and equitable, requiring the same results from everyone (through usually not at the same cost). On the other hand, local regulatory bodies can set more efficient plant-specific requirements based on real costs and specific local environmental conditions. There is a growing acceptance of the need to build serious

dialogue among all the stakeholders in areas where action is urgently needed; in some cases, this involves bringing in professional mediators.

Applying Self-regulatory Mechanisms

While these approaches can be effective, they cannot stand alone. Frustration has grown as improved incentives and information have not improved performance to the expected levels. As a result, there is a surge of interest in Environmental Management Systems (EMS). A good deal of interest has been focused on the development of standards for environmental management - the ISO 14000 series - by the International Organisation for Standardisation (ISO). This series sets out the elements of a system which can be audited and certified, and provides a common basis for development and comparison of EMS. Any company can, and usually should, start with a simple EMS which reflects its character and sophistication. This helps the enterprise gain experience and upgrade its operations.

The ISO 14000 certification may eventually become a practical requirement for success in trading in a small number of sectors and markets, and may also be a useful marketing tool for companies to demonstrate their commitment to environmentally sound behaviour.

Common Effluent Treatment Plants (CETP)

Often, large-scale manufacturers have their own effluent treatment facilities, while small-scale industries (SSIs) face a unique set of challenges in handling their effluents. Some of these challenges are:

- Inadequate understanding of the process of waste generation and treatment.
- Insufficient space for construction of pollution treatment plants.
- Absence of management awareness of waste management issues.
- Insufficient financial resources.

To try and control the pollution problem, industries - along with the government - can set up CETPs at a much larger scale. These CETPs can be expected to help a large number of industries treat their wastewater in a cost-effective way.

The concept of CETP for waste treatment started in the 1990s in India and is now widely accepted in other South Asian countries as well, mainly Pakistan. But it still needs considerable development and effective implementation by the region's industries to achieve its primary aim: arresting water pollution.

The present market for CETPs in India for liquid effluent treatment is worth approximately US $33.5 million, of which US $2.0 million is provided by American firms. The market is expected to grow at an annual rate of 22 per cent for the next two years. Establishing CETPs will open sub-sector markets as consulting services in the fields of environment, financial services, revamping plants, etc.

The United States Asia Environmental Partnership (US-AEP) has a very effective Special Purpose Vehicle for tapping India's industrial CETP business opportunities. It is jointly sponsored by the United States Agency for International Development (USAID) and the United States Department of Commerce (USDOC).

Choosing Effective Market-based Instruments

Financial incentives can be the key to persuasion, and pollution charges (charges on emissions of pollutants or on products whose use or disposal causes pollution) are becoming an increasingly popular instrument for environmental policy. They are now widely applied in the OECD countries and are a key pollution abatement instrument in most transition economies. They have also recently been introduced in developing countries, particularly in Latin America and East Asia.

Theoretically, the advantage of economic instruments over uniform command-and-control regulations lies in their greater flexibility and cost-effectiveness. But poorly designed pollution charge programmes may not yield measurable economic and environmental benefits.

Cleaner Industrial Production

In most developed countries, industry has, for the past 25 years, relied primarily on end-of-pipe treatment for reducing pollution, which has often been the only option for meeting environmental goals. It has also been an expensive approach and not completely effective for reducing pollution from minor sources. Now the more progressive developed countries and industries in those countries are calling for cleaner industrial production (a preventive approach to waste minimisation).

Cleaner industrial production addresses the industrial pollution problem by reducing wastes during the production process, instead of dealing with them after they have been formed. It requires a shift in thinking from the end-of-pipe treatment of industrial pollutants to their prevention altogether. The techniques and technologies for cleaner production go beyond the technologies for pollution abatement and waste disposal: they embrace inside-the-factory changes in

management direction, shop-floor operations, process operations, equipment and even the products themselves.

The problem in developing countries and economies in transition (and even, though to a lesser extent, in developed countries) and with their industrial establishment is that they are not aware of the potential of preventive measures for both reduction of excess process inputs and utilisation of non-product outputs to meet environmental norms. In some cases, they do not have information about the techniques and technologies and in other cases, they overlook the environmental and financial benefits of cleaner production activities. There also are some who do not think that cleaner production techniques and technologies are appropriate for their situations.

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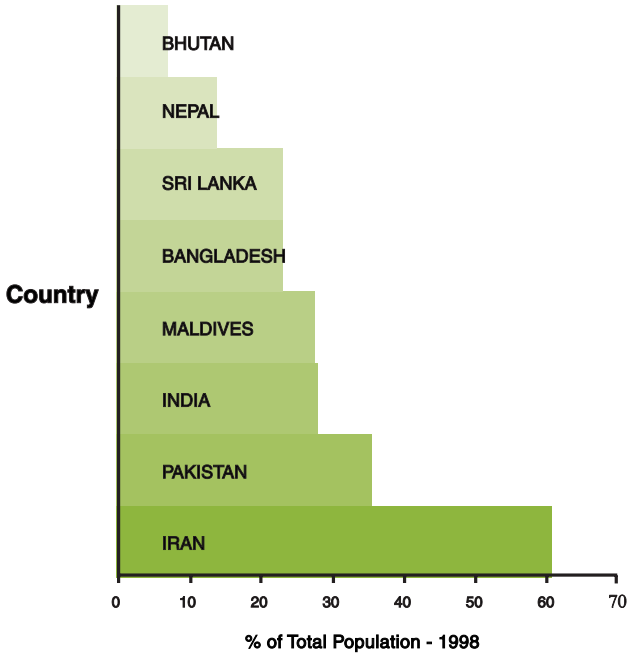
4.0 Urbanisation

Historically, cities have been the driving force in economic and social development. Urbanisation is associated with higher incomes, improved health, higher literacy, improved quality of life and other benefits. These benefits, however, are accompanied by environmental and social ills. These include a diversity of problems ranging from lack of access to clean drinking water to urban air pollution and greenhouse gas emissions. The primary cause for these problems is a rapidly growing population and the fact that governments are unable to provide even the basic needs to their citizens.

The South Asian region as a whole is experiencing rapid urban growth, but is still predominantly rural. The urban growth rate remained high throughout the 1970-90 period. During the 1980s, urban population in the developing countries of the region grew at the rate of 3.0 to 6.5 per cent per annum, which was the second fastest urban growth rate in the world after Africa. Currently, 28.33 per cent of the South Asian population lives in urban areas. The annual growth rate is estimated to be 2.92 per cent in a span of five years.

URBAN POPULATION



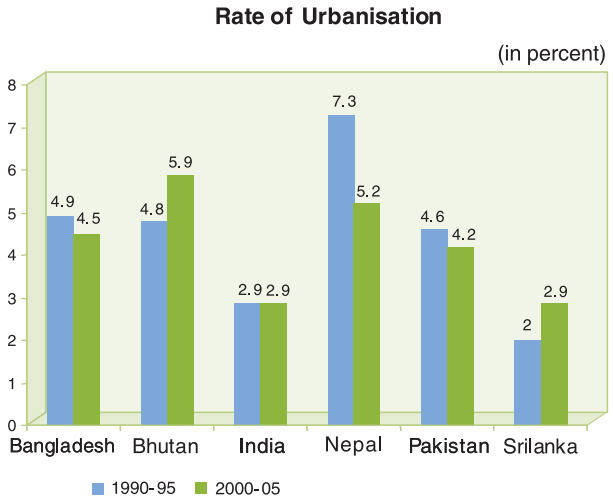
Source : World Development Indicators, 2000

In addition to economic activity, major demographic forces determine urban growth. Some of the chief forces driving urbanisation today are the shifting of jobs from agriculture to industry and the concentration of economic opportunities in urban areas. In the earlier upsurges of industrialisation, rapid urban growth was largely fuelled by rural-urban migration. Migration from rural to urban areas has contributed around 40 per cent of urban population growth during 1970-90 in most developing countries in the region. Another contributor to urban growth is the reclassification of city boundaries, which can result in dramatic changes in sizes of urban centres.

Table 29: Total Population and Urban Population

Country	Total Population *(in thousand)*	Annual Growth Rate (%)	% of Urban Population	Annual Growth Rate *(%)*
Bhutan	2,124	2.7	7	6.1
Bangladesh	1,29,155	1.7	25	5.8
India	1,013,662	1.5	28	2.8
Nepal	22,904	2.4	12	4.8
Pakistan	142,392	2.4	37	4.2
Sri Lanka	18,827	1.0	24	2.6
Maldives	286	2.7	26	3.3
Iran	~60 million	-	~ 60	-

Source: www.unescap.org/pop/data_sheet/2000_table.html, Iran SoE report July 2001



Though the world is getting more crowded with every passing day, absolute numbers of population are becoming less important than locations where people concentrate, how much they consume and whether these areas can cope with them. Simple calculations of population density can be misleading. South Asia has 114 people per square kilometre. But vast regions are virtually uninhabitable and people are concentrated in the more fertile areas along the coasts and cities. Since with urbanisation the concentration of people is increasing in cities, so is the demand for basic necessities such as food, energy, drinking water and shelter. This can have an adverse effect on the area. Moreover, in most of the low- and middle-income countries, development of waste management systems lags woefully behind.

4.1 Migration

Migration from rural to urban areas is one of the important factors leading to the growth of cities. In the South Asian region, around 40 per cent of the urban population growth has been construed to be the result of migration during 1970-1990. In India, rural/urban change is evidenced in the increasing proportion of urban population: between 1941 and 1971; the proportion almost doubled. In 1971, 20.22 per cent of India's population lived in urban areas. During 1971-81, the urban population grew by 46 per cent while the rural population registered a growth by only 19 per cent.

Figures on rural-to-urban migration are difficult to pin down, but it is believed to account for 40 to 60 per cent of the annual urban population growth in the developing world.

Temporary Migration

The most significant migration in the region involves temporary workers. The six countries of the Gulf are important host countries for temporary migrants and provide employment for millions of foreign workers. A majority of these workers come from South Asia. Nearly one million workers from South Asia - mostly from Bangladesh, India, Pakistan and Sri Lanka - emigrate each year to the Middle East. Despite the employment of temporary labour migrants, Gulf countries do not encourage nor accept permanent immigrants. For their part, South Asian governments continue to rely on migration to resolve employment pressures and for remittance incomes to fuel their economies. Although Bangladesh, India, Pakistan and Sri Lanka have a high participation in temporary labour migration, permanent settlement abroad is common only among Indians and Pakistanis.

Migration is also encouraged by conflicts, whether internal or external. South Asia has the fourth largest concentration of refugees in the world. A majority of displaced persons who have crossed international borders in this region are not regarded as 'refugees' by the host governments. They are usually treated as 'undesirable aliens' or 'illegal immigrants'. In Sri Lanka alone, more than a million people have been rendered homeless within their own country by the 12-year-old ethnic conflict. In India, nearly 2,50,000 Kashmiri Hindus and Muslims have become internally displaced.

4.2 Employment Opportunities

Unemployment is a pressing concern in most cities in the South Asian countries because the formal economies are unable to absorb the enormous influx of workers. Given the urbanisation rates, these cities are now experiencing intense demands for jobs. As a result, a substantial number of the developing world's urban poor makes its living through subsistence activities or informal jobs - namely, production and exchange outside the formal market. These jobs run the gamut from providing services such as garbage collection and domestic help, to providing goods such as food and building materials in small stores, to small-scale clothing manufacturing.

Debates on the role of the so-called informal sector in national economies are common. Until recently, informal jobs had been viewed as disconnected from the 'real' economy of a city; evidence now suggests that informal jobs are well integrated and contribute directly to the urban economy as a whole.

4.3 Urban Poverty

Several factors, including structural adjustment programmes, economic crisis and massive rural-to-urban migration, have contributed to an increasing number of urban poor since the 1980s.

The World Bank estimates that in 2000, the region is home to 40 per cent of the world's poor.

Available poverty figures are likely to underestimate the extent of urban poverty because global data is scarce. The issue is complicated by the fact that definitions of poverty differ from country to country. In addition, absolute poverty figures describe households whose incomes fall below a predetermined level, usually estimated by how much money would hypothetically be required to buy a basket of basic goods and services. Poverty lines, however, are often set unrealistically low. In some countries, the poverty line is set at the same level for both urban and rural areas, not taking into account the higher costs of living in cities.

Poverty can neither be adequately described as just a lack of economic resources, nor as a lack of access to basic needs. Poverty also involves relative deprivation or inequality in access to income and material goods and services - and in most countries, income inequalities are wider in the city than in the countryside. Another shortcoming of income-based measures of poverty is that they do not describe the numbers of people who hover just above the poverty line and can easily be thrown into poverty by any number of setbacks, such as the loss of a job or sudden illness.

Environmental Implications of Urban Poverty

The urban poverty has implications for the urban environment and its quality of life. For one, the urban poor bear the greatest burden of urban environmental risks because of the situations which they are forced to live in – in the sprawling squatter settlements of the cities in the developing world.

Slums and squatter settlements:

A large number of rural migrants are unwelcome additions to an already inflated urban unemployment situation. These migrants are forced to settle in slums and squatter settlements characterised by high population densities, poor quality of housing, lack of water supply, sanitation and waste disposal facilities, which can lead to spread of communicable diseases.

Regardless of country, the fundamental issue for the urban poor is access to land. Land occupied by urban poor is often unsuited for settlement; much of that land is often illegally occupied, and therefore characterised by insecurity of tenure. Fearing that provision of infrastructure and public services will be taken as de-facto legitimisation, governments usually decline to serve these sections. Illegality is closely linked to government unwillingness to recognise community-based organisations seeking to secure basic infrastructure and services.

4.4 Stressed Infrastructure and Management Systems

Urban areas affect the environment in three major ways: through the conversion of land to urban use, the extraction and depletion of natural resources, and the disposal of urban waste. The impacts of this pollution are experienced both locally and at great distances from the source. For instance, domestic and industrial discharges contaminate air, land and water much beyond the immediate vicinity. The increased levels of consumption characteristics of the population of urban areas lead to generation of copious quantities of waste. These problems warrant major concerns on three

Table 30: Average Floor Space per Person in Urban Settlements

Country	City	Average floor space per person *(sq.m)*1999
Bangladesh	Dhaka	2.7
India	Mumbai	3.5
	Delhi	6.9
	Chennai	6.2
	Bangalore	9.5
	Luchnow	5.5
	Varanasi	4.5
Nepal	-	-
Pakistan	Lahore	1.2
Sri Lanka	Colombo	18.7
UK		34.8
China		16.3
New Zealand		40.0
Australia		55.0

Source: World Bank 2000, WDI

accounts: firstly, the prevailing pattern and trend of urbanisation is even more material- and energy-intensive. Secondly, the discharge of pollutants in cities is particularly harmful because they are concentrated, and thirdly, the financial, institutional, technological and infrastructure systems available to help control these problems in the region at present seem to be inadequate.

A recent World Bank study has estimated that developing countries as a whole invest about $200 billion per year in physical infrastructure facilities. This is about 4 per cent of their GDP. About four-fifth of this, i.e. $160 billion is financed through domestic public resources, about one-sixth, i.e. $25 billion through international development assistance, and the remaining about $15 billion through private capital. Future investments needed are expected to be much higher because of demand created by increasing population, rapid urbanisation and changing lifestyles.

Urban Waste

Increasing population, urbanisation, industrialisation and rising and changing consumption patterns are resulting in the generation of increasing amounts of solid waste across the entire region. By the year 2020, an additional 1.5 billion people will be added to Asia's population, and with the rapidly swelling urban population the requirement for infrastructure and services too would increase manifold. Solid waste collection and disposal is one such service which needs to be adequately provided to ensure an urban environment conducive for living.

The total amount of municipal solid waste generated in the region amounted to about 700 million tonnes per annum in the mid-1990s.

Solid waste:

Solid waste in urban settings is municipal and industrial solid waste. Although Asian cities have a lower rate of waste generation than cities in the West, their quantum of waste is high owing to their higher levels of population density and low technology. The tropical Asian climates, with a high degree of rainfall and humidity, aggravate the problem of solid waste disposal, especially as the common waste disposal method is open dumping. The level of leachability from the dumped waste increases as a result of high precipitation.

As countries become richer and more urbanised, their waste composition also changes. The substantial increase in the use of paper and packaging is probably the most obvious change. The next most significant change is the higher proportion of plastics, multilateral items and consumer products and their related packaging material in the solid waste. A negative side of greater affluence is that it brings with it more wastes of higher volume, making it more expensive for management.

Improper collection and disposal of solid waste: The collection of refuse presents peculiar problems, as household wastes are thrown out indiscriminately. Unskilled labour is used to clean the streets and collect the garbage. It is estimated that 20-50 per cent of the solid waste generated remains uncollected, even though up to half of the local operational expenditures often goes towards waste collection. In low-income or squatter settlements, garbage collection is often non-existent, as these settlements fall outside "official" service areas, or trucks are unable to manoeuvre along their narrow unpaved streets.

Even if collected, municipal solid waste disposal remains a problem in many cities. Municipal solid waste sites often handle both domestic and industrial waste, including hazardous wastes. Without proper disposal processes, toxic chemicals from the wastes leach into water supplies.

With rise in living standards, the amount of organic content in the waste declines, and that of non-biodegradable wastes such as metal, plastic and glass increases. Urbanisation and rising incomes, which lead to more use of resources and therefore more wastes, are the two important trends that factor into rising waste generation rates. The Indian urban population is expected to produce far more waste per capita than its rural population. The difference between the rural and urban population waste generation rates also exists in Bangladesh, where the rural population generates only 0.15 kg per capita per day, while its urban counterpart generates 0.4-0.5 kg per capita per day (*World Bank 1998*).

In fact, South Asian cities are drowning in their own waste. In New Delhi, India, 3,880 tonnes of garbage is produced each day, yet only 2,420 tonnes is collected for disposal. Dhaka in Bangladesh manages to collect 50 per cent of the waste produced by its city. It has

been estimated that the total amount of land required per year for the disposal of this waste would be 95 hectares (234.65 acres). Kathmandu, Nepal, faces similar challenges (www.makingcitieswork.org/).

While there is considerable variation in the collection of waste and its transport in South Asia (not only from country to country, but within sections of one urban area), there are some common issues. The most important of these is the irregularity or lack of municipal service for squatter settlements or congested low-income areas. Collection rates vary from 20-90 per cent of the total municipal wastes. The frequency of scheduled collection is partly governed by climate, and by the system in use. In the Indian subcontinent, temperatures are high and the system is often 'open' (i.e., the street containers and transfer points are not covered and the waste is exposed). Irregular and inadequate collection is usually a function of the legal and economic status of the neighborhood. Many illegal settlements are not entitled to waste services. A contributing factor is that municipal collection crews have less incentive to pick up garbage from poor neighborhoods as the wastes contain fewer recyclables that the collectors can sell.

Recyclables are extensively traded - even internationally - particularly in the subcontinent. For instance, almost all the recyclables of Nepal are exported to India, this trade being controlled by Indians. Surplus materials from Kolkata, India are exported to Bangladesh. The most lucrative cross-border trade is that from Afghanistan to Pakistan (*www.makingcitieswork org/*).

Hospital waste:

Wastes from hospitals may be either biodegradable or non-biodegradable. These may be paper, glass, tin cans, injection needles, human waste, blood, body fluids, etc. The biodegradable wastes can be disposed off easily, but chemical wastes such as corrosive acids can be inflammable and hazardous. A few hospitals are adopting waste management techniques such as segregation and incineration. However, there is still a problem in handling wastes in this sector.

Industrial waste:

The process of industrialisation has contributed to the accumulation of toxic chemicals at an alarming rate. These toxic materials can cause acute illness or death. The sedimentation of toxic substances in air, water and

The Plastic Menace in India

The phenomenal use of plastics by masses in the region started in the '80s. In the new age of convenience – consumerism — we end up wasting as much we consume. We pay more for the packaging than for the product. Nearly a quarter of India's precious energy is used for producing what ultimately turns out be a waste. In 1996, the biggest users of the plastics in India were industries related to infrastructure, agriculture and water management. The use of plastics in packaging was 25 per cent, a figure which has now increased to a gigantic 52 per cent (1998). It is projected that India will be consuming nearly 4 million tonnes of plastic annually by the turn of the century.

Source: Plastics in Our Lives by Dr Iqbal Malik, Vatavaran report, March 1996

Only 40 per cent of the region's urban population has access to sanitation services.

Table 31 : Composition of Urban Solid Waste in South Asia *(in %)*

Type of waste	Nepal *(Municipal solid waste)*	Bangladesh *(Domestic)*	India *(Municipal solid waste)*	Sri Lanka *(Domestic, commercial)*
Compostables	80	84.37	41.8	76.4
Paper	7	5.68	5.7	10.6
Plastic	2.5	1.74	3.9	5.7
Glass	3	3.19	2.1	1.3
Metal	0.5	3.19	1.9	1.3
Others	7	1.83	44.6	4.7

Source : World Bank Urban Development Sector Unit, Solid Waste Management in Asia(1999)

soil pollute the entire ecosystem. Many industrialised countries have targeted South Asia for dumping their hazardous wastes. This is perhaps due to less stringent environmental standards and lack of regional cooperation on controlling the waste trade. With economic growth and complexity of economic production, the rate of hazardous waste generation is also expected to increase in the near future.

While there has been some success in involving the private sector in the construction and operation of high-technology solutions such as incineration and treatment, a lot more needs to be done in collection and disposal services to deal with the extra waste. Most countries are now focusing on low-cost and potentially highly effective technology for waste reduction and avoidance, including economic instruments and recycling schemes.

Impacts of Improper Solid Waste Management

The current/existing handling and disposal practices of solid wastes result in the several hazards that are associated with them. It promotes micro-organisms and vectors that breed diseases and generates noxious odours. Improper solid waste management can lead to pollution of air, soil and water. Indiscriminate dumping of wastes contaminates surface and groundwater supplies. In urban areas, solid waste clogs drains, creating stagnant water, which function as breeding grounds for insects and which can lead to floods during rainy seasons. Uncontrolled burning of waste and improper incineration contributes significantly to urban air pollution. Greenhouse gases are generated from decomposition of organic wastes in landfills and the untreated leachate pollutes surrounding soil and water bodies.

Integrated Solid Waste Management (ISWM)

An effective, efficient and sustainable waste management system is still lacking in the region's urban areas. Integrated solid waste management is defined as the selection and application of appropriate techniques, technologies and management programmes to achieve specific waste management objectives and goals. Understanding the relationship between various waste-related activities makes it possible to create an ISWM plan where individual components compliment one another. Waste hierarchies are usually established to identify key elements of an ISWM plan. The general waste hierarchy accepted by industrialised countries comprises of the following order - Reduce, Reuse, Recycle, and Recover through physical, chemical or biological processes. The cost of collection, treatment and disposal, in such cases, needs to be reduced through various mechanisms.

The main objectives of this strategy should be:

- Prioritise waste avoidance over recycling, and recycling over the other forms of environmentally sound disposal methods.
- Reduce non-avoidable wastes as far as possible.
- Maintain the content of hazardous substances in wastes at as low a level as possible.
- Guarantee environmentally sound residual waste treatment and disposal as basic requisites for human existence.

Cities are using a variety of regulatory and economic instruments to reduce industrial wastes. Effluent charge systems, for example, impose fees on industrial facilities according to the quantity and quality of pollutants discharged. These systems are more economical than regulatory mechanisms and hence, effective in inducing firms to reduce pollution loads. Cities should encourage the separation of industrial wastewaters from the domestic wastewater streams, and ask for separate treatment of industrial wastes or pre-treatment before they are discharged into sewers.

Greater attention towards segregation of different kinds of wastes at the collection point itself will reduce the cost of disposal. Toxic waste should be collected and disposed of separately. Biodegradable waste should be tackled locally to avoid storage and transportation over long distances.

In developing countries the municipal system handles only a fraction of the waste generated in a city. In many cities in Asia, more wastes are dealt with by a vast network of urban wastepickers. In Bangalore, India, street and dump pickers gather an estimated 500 metric tonnes of post consumer waste daily, compared with only 37 metric tonnes gathered by municipal workers.

Urban Water Quality

Ever increasing urban populations and their growing amounts of wastes have over-taxed the natural recycling capabilities of local rivers and lakes. Of the many problems associated with urban effluents, nutrient loading or eutrophication of local waters is one of the most serious. Nutrients are essential plant foods, but excessive amounts can cause radical plant growth – such as massive algal blooms, for example — that block the sunlight that other organisms need. As the plants die and decompose, the dissolved oxygen in the bottom waters is depleted – a condition that is deadly for fish and other aquatic life.

Wastewater treatment facilities are inadequate in many cities of the South Asian region. At many places, untreated industrial wastes are discharged directly into canals and rivers, thus creating conditions for the spread of diseases.

Urban health and safety hazards:

Health and safety issues also arise from improper solid waste management. Human faecal matter is commonly found in municipal waste. Insect and rodent vectors are attracted to the waste and can spread diseases such as cholera and dengue. Using water polluted from solid wastes for bathing, cooking, irrigation or for drinking can expose individuals to diseases, organisms and contaminants. Various diarrhoeal and other diseases are spread via the faecal-oral route, and this route is much better facilitated where water supplies and sanitary conditions are inadequate.

Providing adequate supplies of water for burgeoning urban populations is both difficult and expensive. Many cities in developing countries have already tapped all existing water supplies and now must bring water from great distances or reprocess used water. Better management and reduction of losses from leaks and diversions could facilitate large savings.

Urban Transportation

During this century, the transportation sector has achieved the status of a key stimulant of economic growth. But alongside its many economic benefits, the relentless expansion of the sector in terms of vehicle fleets, infrastructure, passenger and freight kilometres has also created a host of environmental problems. Consumption of non-renewable energy sources, adverse impacts on land use, emission of air pollutants, oil slicks in marine environment, and growing congestion on urban roads are some of the problems associated with transportation growth.

Introduction of electric vehicles to replace three - wheeler diesel vehicler : an encouraging endeavour for controlling air pollution in Nepal (B.Banmali)
Source: Nepal:State of the Environment 2001

To curb increasing vehicular air pollution, Nepal has initiated the conversion of three-wheeler diesel tempos known as 'Vikram' in the valley to electric-powered, battery-charged and LPG three-wheelers called 'Safa' tempos.

Source: ICIMOD, Nepal

In particular, transportation systems are a major contributor to the decay of urban environment and reduced quality of life in metropolitan areas due to their contribution to atmospheric emissions, noise and risk of accidents. Besides, the transport infrastructure has encroached into agricultural forest and urban land resources, which are becoming increasingly scarce in the region. There are instances of significant loss in agricultural land and deforestation caused by the construction of transport corridors. Perhaps the most serious and pervasive impacts of construction of transportation corridors stem from the draining of resources from rural to urban areas with the appearance of sprawling and unplanned urban settlements leading to numerous environmental problems.

The trends in the transport sector clearly depict a pattern of expansion in every mode of transport. The expansion is, however, not uniform across different countries or different modes. In both cases, road transport remains the most dominant mode in the region.

In fact, the rapid growth of road transport - particularly the increasing proportion of private vehicles - is relentlessly degrading the region's environment. Despite the fact that railways constitute one of the most energy-efficient and environment-friendly means, their growth is quite moderate. In some countries in the region, even this mode is on the decline both in terms of freight and passenger service. The process of modernisation of the railway system, however, is underway in many developing countries of the region. India has electrified about 25 per cent of its total track length. Air transport systems in the region exhibit a growth pattern similar to that of the other transport modes.

Inefficient traffic planning and related problems:

It is not the extent of the transportation system that is a cause for alarm from an environmental standpoint. What might have worrying implications are the growth trends, quality, spatial and operational patterns and modal

Growing menace of urban transportation
Source: Survey of the Environment, The Hindu, 1998

shift. The concentration of population and economic bases in large cities, combined with inadequate investment in transportation infrastructure, has led to unplanned expansion and poor energy efficiency in the sector, which has resulted in adverse effects on the environment.

Congestion is perhaps the most visible manifestation of the failures in urban transportation planning. It undermines the central purpose of the automobile: ready access to people, goods and services. Clogged city streets exert a major toll on economic productivity and exacerbate air and noise pollution. In many cities at the peak period, traffic creeps along at less than 10 km per hour. Congestion is the result of insufficient road network, thus even a relatively few vehicles can cause an intense gridlock. Yet, expanding the road network is rarely an adequate solution. Such improvements are beyond cities' financial resources.

Increasing vehicular pollution in major urban centres is becoming an area of growing concern. Poor maintenance of vehicles, degraded condition of roads and use of dirty fuels primarily precipitate the problems of air and noise pollution arising from operation of motorised vehicles.

Traffic congestion and related pollution also have other negative impacts on urban areas. They compel investors to stay away to avoid the related inefficiencies, creating economical disbenefits instead of facilitation. The tourism industry, which many developing countries of the region rely on for foreign exchange earnings, has been hurt in congested cities. Potential tourists have been staying away to avoid pollution and congestion.

Traffic noise:

Data collected along heavily travelled roads in Mumbai in India indicate sound levels of 65 to 85 dB. The noise of thousands of vehicles operating in close proximity to people leads to hearing loss, stress and many psychological disorders. Poor conditions of vehicles in developing countries further aggravate the problem. Noise pollution from higher volumes of road traffic is a threat to the residents of major urban settlements.

Growth in motor vehicle ownership:

Income levels greatly influence the mode of transport people use and the number of trips they make. In general, with the rise in incomes there is a marked increase in vehicle ownership. For those who can afford them, cars provide a fast, covenient and relatively inexpensive mode of travel. The estimated total

Black smocks emitted from the vehicler does not bother road ride food venders
Source: Bangladesh:State of the Environment 2001

Vehicular growth in Delhi
Source: India:State of the Environment 2001

Table 32: Growth in Number of Motor Vehicles

Country	Motor vehicles				Passenger cars		Two wheelers		Road traffic	
	per 1,000 people		*per kilometre of road*		*per 1000 people*		*per 1000 people*		*million vehicle (per Km)*	
	1980	**1998**	**1980**	**1998**	**1980**	**1998**	**1980**	**1998**	**1980**	**1998**
Bangladesh	-	1	-	1	-	1	-	1	-	-
India	2	7	1	3	-	5	-	24	-	-
Nepal*	-	9	-	16	-	2	-	5	-	-
Pakistan	2	8	5	4	2	5	3	14	-	31,950
Sri Lanka	-	34	-	7	8	15	6	40	-	15,630

*Source: WR, World Bank 2000, *data from ICIMOD, Nepal*

In India, between 1970 and 1990, the number of vehicles has grown 11.5 times - from about 1.9 million to more than 21 million. At the same time, the figure per thousand population has increased from 3.4 to 25.31, and is expected to exceed 40 by the year 2000.

The potential of air pollution is affecting crop yield has been demonstrated by a study in Pakistan, where 40 per cent reduction in rice yields was measured and linked to the presence of gaseous pollutants in the ambient air.

number of registered vehicles in the region in 1992 was over 130 million, with an annual growth rate of 3 to 4 per cent. However, increased automobile ownership leads to increased travel. In some countries, the number of trips by cars is growing faster than the number of cars.

Urban Air Quality

The surge in energy demand characterised by the region's dependence on coal has manifested itself in major increases in airborne pollution. Urban air quality has deteriorated largely on account of growth in industrial activity, transportation needs and energy production.

Release of huge emissions of smoke into the air by brick kilns in the Kathmandu Valley (B.Banmali)
Source: Nepal:State of the Environment 2001

Flyash, combined with emissions from the increased use of coal, has emerged as a major environmental concern in the region. It is estimated that about 35-40 million tonnes of flyash is generated by thermal power plants each year in India, of which a mere 2-3 per cent is recycled. The effects of burning coal and the resultant air pollution tend to spread over large areas, resulting in acid deposition in areas near the coal-burning plants as well as further away.

In India, ambient air quality status derived from a network of 290 stations covering 90 towns and cities in recent years indicates that while suspended particulate matter (SPM) is consistently critical in many cities, the concentration of nitrogen oxides and sulphur dioxide is also increasing and is already transiting from moderate to high to critical levels. As estimated, 2,000 metric tonnes of air pollutants are emitted into the atmosphere every day. Vehicular sources contribute about 63 per cent of total pollutants emitted, followed by 29 per cent by industries and thermal power plants, and 8 per cent from the domestic sector (*TERI, 1996*).

The recent order of the Indian Supreme Court disallowing registration of private non-commercial vehicles failing to conform to Euro-II fuel emission norms, in the National Capital Region (NCR) from April 1, 2000 onwards has added novel dimensions to the public debate on eco-friendly and sustainable urban transport systems.

In Nepal, vehicular emission is the major cause of deteriorating air quality due to the use of substandard or adulterated fuel. In Dhaka, 50 per cent of SO_2 and NO_2 emissions are contributed by vehicular traffic. Also, the numerous brick kilns operating seasonally all over Bangladesh use coal as their source of energy. In Bhutan, incidences of air pollution arise from heating appliances that use fuelwood, and vehicular emissions. Though the environment of the Maldives is still in a sufficiently pristine state, it is very susceptable to stress from trans-boundary pollution.

Effects on the global environment:
Vehicular emissions affect not only local environments and economies, but also the global ecosystems. Vehicles account for 14 per cent of the world's emissions of carbon dioxide - the primary greenhouse gas in the global warming threat. Nitrogen oxides and hydrocarbons act together to form ozone, also a greenhouse gas. The presence of another vehicular emission, carbon monoxide, can lead to a higher ambient concentration of methane which is a another potent greenhouse gas. Finally, chlorofluorocarbons, leaked from air conditioners of vehicles, are not only potent greenhouse gases, but also the main known cause of atmospheric ozone depletion.

Although the state of transport systems is an important determinant of the regional dispersion of economic activity as well as a facilitator of economic growth, transport policy in the region seems to be impromptu and need-driven. There appears to be inadequate importance given to the planning and capitalisation of the transportation infrastructure.

Currently, the countries of the region are placing a high emphasis on the end-of-pipe approaches to address the problem of air pollution, largely manifested in regulations concerning vehicular emission standards. Fiscal and technological measures have also been undertaken to reduce pollution. Other measures include:

- *Improving public transportation facility:* The challenge is to expand and improve the transportation system and thereby discourage over-reliance on privately owned cars.
- *Cleaner fuels:* Alternative fuels including compressed natural gas (CNG) and LPG are receiving increased attention as potential pollution reducers. CNG is being already used in Indian public transport buses. A high priority for developing countries is to reduce lead content in gasoline. The costs of eliminating lead from gasoline and of eliminating older vehicles have made it difficult for South Asian countries to switch to unleaded fuel.
- *New vehicle technology:* Opportunities also exists to improve efficiency and cleanliness of motor vehicles. Zero emission vehicles could greatly improve air quality, health and quality of urban life.
- *Vehicle inspection and maintenance:* Older vehicles account for a disproportionate share of air pollution. A badly maintained old vehicle can emit 100 times more pollutants than a properly maintained modern vehicle. Effective inspection and maintenance programmes can reduce emissions from old vehicles and ensure good condition of new vehicles. Such programmes need more attention in developing countries.

4.5 Consumerism

Energy Demand

Urbanisation has a profound impact on the amount and type of energy consumed. Along with population growth, economic development and industrialisation, urbanisation is one of the principal forces driving the increase in global energy demand. Although traditional rural societies rely heavily on human and animal energy and on nearby wood or fuel, urban societies today are characterised by their reliance on fossil fuels and electricity. These patterns of energy use lead to different environmental impacts.

In the developing world, the per capita energy consumption remains low (*for details, see 'Energy Security', page 44*). In South Asia's urban centres, the consumption of energy is more than in its rural belts primarily because of the use of more home appliances run by electricity as well as the use of private transport. Urban dwellers are more likely to travel to work via energy-intensive modes of transportation. Urban manufacturing and industry are more energy-intensive than traditional farming.

Water Demand

The South Asian region has enormous reserves of water, but it still suffers from urban water supply problems. The growing demand for water, along with poor water resource management and mounting pollution levels, contributes to water supply problems in and around cities. Urbanisation is leading to changes in lifestyle and consumption patterns, which, in turn, is leading to increased demand for water. Industrial demand for water is also on the rise. As the number of people in urban areas increases, so does the demand for food and hence for irrigation in agricultural areas which are close to cities. These pressures can quickly result in a consolidated demand for water that surpasses local water supply.

Poor water management practices exacerbate local water shortages. Water is usually priced much lower than the actual cost of treating and distributing it (in part because of government subsidies), leaving little incentives for households and industries to conserve the resource. Inefficient water distribution system is another major source of water loss. Water scarcity is also closely linked to water quality. According to a World Bank report, many cities of South Asia have to make do with leaking water supply pipelines, which means that between 20-50 per cent wastes seep into the public water supply system. Freshwater lakes and rivers provide affordable and easily accessible water, but uncontrolled discharge of domestic sewage and industrial effluents into them has left many urban rivers heavily polluted and their water unsafe for use. Consequently, cities search for water supplies well beyond their boundaries - which leads to conflicts.

Such conflicts among urban, industrial and agricultural users may assume partcularly severe proportions in the South Asian region. Already struggling with uneven distribution of water resources and local water scarcity, the urban population of this region is expected to double in less than 25 years. In India, total water demand is projected to double by 2025. Although agriculture will still claim bulk of water supplies, demand is growing fastest in urban and industrial sectors and is projected to reach 135 per cent over 40 years.

Responses

Environment Priorities for South Asian Countries

Towards sustainable cities:

Sustainable development is defined as meeting the needs of the present without undermining the resource and ecological base of the future generations. Cities are clearly central to meeting the goals of sustainable development. The majority of the world's population will soon live in towns and cities. World-wide city-based producers and consumers already account for most of the renewable and non-renewable resource consumption and waste generation. These long-term ecological concerns are relevant to cities in the developing world. As these cities grow and prosper, their consumption of resources and generation of wastes will rise accordingly, unless actions are taken now to promote the efficient use of resources and minimisation of waste.

The challenge for all cities is to seek new management approaches that provide for the needs of urban residents, as well as protect environmental resources on which human life depends. A narrow focus on sustainable cities can lead to the idea that cities should draw on natural resources from within the immediate region, which seems increasingly at odds with the globalisation of the world economy.

Integrated transportation and land use patterns:

Two major issues that pose great challenges to policymakers in the transport sector is energy efficiency and pollution control.

A multi-pronged approach, using innovative regional and sectoral development policies, is needed to address the current transportation problems related to environment, and also to seek proactive means of addressing future developments.

While it might be difficult and costly to impose stringent emission standards, fiscal measures can be employed to lower prices of lead-free gasoline and energy-efficient vehicles that are also low on emissions. Adoption of new traction technologies employing electric and other low-emission motors can be actively explored too.

The region has undertaken some fiscal and technological measures to reduce pollution as well. For example, charges have been introduced on leaded gasoline. The use of compressed natural gas (CNG) is being considered as a comparatively less polluting alternative.

It is of utmost importance to build energy-efficient mass transit systems for commuters in the existing major cities, as well as those for the transportation of goods and people between major industrial and population centres. This requires huge amounts of investment as well as considerable planning and design, for which the countries of the region need to be extensively assisted.

The existing road networks in major cities and between them need to be vastly improved to create a reasonable flow of traffic. This would also ensure reduction in levels of harmful emissions per km of travel. This measure should be taken in conjunction with measures designed to reduce traffic volume.

An attempt should be made to disperse further economic activity regionally rather than concentrate it in large urban centres. The decentralised production centres so formed should, however, be designed to

integrate various types of manufacturing activities into creating relatively closed regional sub-economies, rather than specialised ones dependent on large volumes of trade flows between regions. It might be useful, in this context, to promote information and communication technologies so that people can work from bases close to where they live and submit work, talk and conduct meetings through the electronic media.

Land is recognised as valuable in its natural state and is not simply seen as a raw material for urbanisation. Studies on whether high densities should be concentrated in one centralised location or in many smaller modes for maximum energy-efficiency, remain inconclusive. Transportation infrastructure development rather than land use planning may be far more influential in determining where development will take place. Without coordination of land use and transportation planning at the outset, chances are that cities will develop increasingly car-dependent forms.

In addition to the constraints to successful land use planning, another key roadblock in developing countries is poor institutional capacity to manage urban land.

Infrastructure planning

Community participation: Essential services such as water supply, sanitation and garbage collection in low-income settlements are not readily provided by individual action. Neither does increase in individual family income necessarily lead to improvements in neighbourhood living conditions. Instead, these are neighbourhood and community issues requiring collective action. However, if people do not feel a sense of security in their households or in the fact that they are members of a community, they are not likely to devote their energies to improving environmental conditions.

Awareness of waste management and conservation: Cooperation and participation of the community in solid waste management is essential in implementing any solid waste management strategy. Reduction, reuse and recycling of waste cannot be performed without such an active participation. In fact, community involvement in the decision-making process in developing solid waste management strategies should be encouraged at its inception to make the implementation of any solid waste management programme a success.

The national policies should be aimed at reduction of waste by encouraging producers and consumers through education and awareness. Sorting of waste at source plays an important role for getting private sector partnership in solid waste management, especially in the recycling industry. The growing volume of waste spawned by the consumption inherent in city life is a formidable challenge for low-income cities; the main solid waste problem is how to extend the collection services to the poor - often, 50 per cent of the population goes without a waste collection service.

With the increasing recognition of the value of informal waste collection for urban functioning, efforts are now under way in a number of cities to integrate these activities into formal urban economy and minimise the health and safety risks of waste collection for those whose livelihood depends on it. Many of these efforts are driven by NGOs or community-based organisations, and face the organisational and financial difficulties common to voluntary efforts. As a result, few projects have led to city-wide programmes, and many have not survived even on a small scale.

In cities of the developing world, only a fraction of urban sewage is treated. This is partly because the costs of collecting and treating urban sewage is high. Therefore, lower cost treatment options are clearly needed. These options should have some capabilities to remove nutrients and accomplish more additional treatment goals. Another option involves the reuse of municipal wastewater. Biosolids can be separated out, composted and reused as fertiliser, while the treated effluent can be used to irrigate landscaping or crops or to feed aquaculture ponds. Innovative technologies alone will not suffice. Especially in the developing world, there is a critical need to develop the institutional capacity to plan, finance and efficiently operate and maintain conventional wastewater treatment systems.

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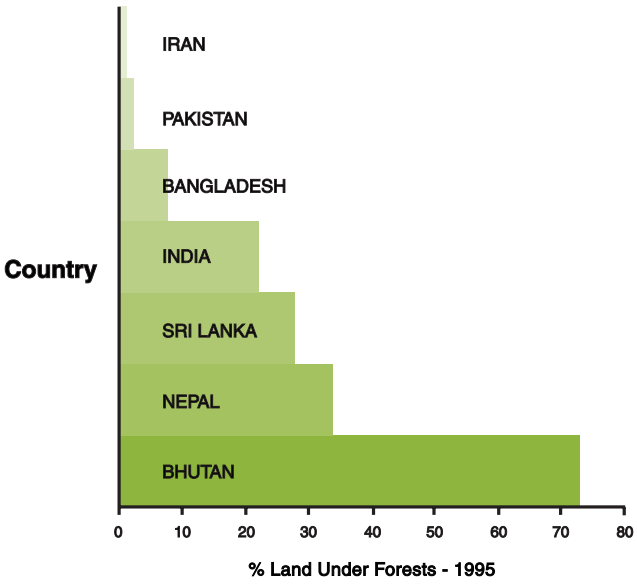
5.0 Biodiversity

South Asia* is home to spectacular natural beauty and biological wealth. The region's geographical expanse and topography include several diverse ecosystems which harbour a rich variety of faunal and floral species – the Sunderbans, the largest contiguous mangrove swamp in the world, in India and Bangladesh; magnificent coral reefs and atolls in the Lakshadweep-Maldives chain of islands; the Thar desert and arid areas in north-west India and southern Pakistan; high altitude cold deserts in the upper Himalayas and Deosai plains in Kashmir; two rich biodiversity hotspots in the eastern Himalayas (Nepal, north-eastern India, and Bhutan) and the Western and Eastern Ghats of India and Sri Lanka; and the dense and virtually untouched virgin forests of Bhutan and Sinharaja, the ancient forest in Sri Lanka.

The diversity in the latitude, altitude, climate, topography and rainfall patterns plays an important role in determining the vegetation of the area. The monsoon rainfall pattern, unique to the region, principally distinguishes the forests into evergreen (which receive 2,500 mm rainfall per annum), deciduous (1,000-2,000 mm), dry forests and scrubland (500-1,000 mm), and desert and semi-desert (less than 500 mm). Forests cover an area of approximately 7,71,37,000 ha *(Source: WRI, 2000)* of the total land area (4,122,97,000 ha) of the region - i.e. 18.6 per cent of the land area of South Asia is under forests, which accounts for approximately 2.93 per cent of the world's forest cover.

FOREST COVER



Data not available for Maldives
Source : World Development Indicators, 2000

These forests and ecosystems are home to nearly 42,288 species of higher flowering plants and 6,472 species of fauna (mammals, birds, reptiles, amphibians and freshwater fishes). Of these, 9,257 species of vascular plants and 824 species of animals are endemic to the region. Thus, occupying an area of 44,49,060 sq. km. approximately - i.e., only 3.2 per cent of the world's land area - South Asia accounts for nearly 15.6 per cent of the global floral and 12 per cent of the faunal diversity.

Right : Sal Shorea robusta forest in the low lying terai belt of the India/Nepal border. This forest is interspersed with tall wet grassland which is under pressure from drainage for agriculture. The wet grasslands are home to the threatened swamp francolin Francolinus gularis (bird all).

* Does not reflect data of Iran

Table 33: Forest Types in South Asia

Forest Types	Location	Dominant species
Tropical wet evergreen and semi-evergreen forests >3,000 mm	Assam Hills and Western Ghats of India , south-western Sri Lanka	Multi-storied emergents; epiphytes are abundant. Herbs poorly developed. Species numbers are high.
Tropical Deciduous (monsoon) forest	Peninsular India	Trees include Tectona grandis (teak), Shorea robusta (Sal), terminalia chebula and Acacia catechu.
Thorn forest < 750 mm	North-west of the peninsula and western ghats (India)	Thorn forest grades into xerophytic bushland and desert vegetation.
Tropical dry evergreen forest	Madras (India) to Point Calimere	The canopy is closed and low (1-13 m), with an understorey of spiny shrubs.
Montane subtropical and temperate forests	Nilgiri hills, Anamalai hills and Palni hills of South India Sikkim Assam and Meghalaya; Nepal, Bhutan	Species of Fraxinus and Shorea robusta in favourable sites; climbers and epiphytes are also common.
Subtropical moist pine forest	Khasia Hills and mountains of Assam (India) and southern slopes of Himalayas (900-1,800 m)	
Subtropical dry evergreen forest	Kashmir(salt range), Himalayan foothills and scattered patches in Baluchistan (Pakistan) (100-1,525 m)	Low scrub, with dwarf palm Nannorrhops dritchieana together with Acacia modesta and Olea cuspidata.
Northern wet temperate forest >2,000 mm	East of longitude 88degree E occurs east of longitude 88^0 E, between 1,800-2,900 m	Dominated by Quercus, Castanopsis and Laurus with dwarf bamboo undergrowth.
Himalayan moist temperate forest (1,000-2,500 mm)	Himalayas (150-2,500 mm)	Mixed broadleaved evergreen and coniferous forest with rhododendron, oak, laurel and bamboo undergrowth.
Alpine forest and scrub	Himalayas (2,895-3,660 m)	Above tree-line, >4,000 m, vegetation changes to open *Rhododendron* scrub and alpine pasture. Wet areas are rich in herb flora - *Primula* and *Pedicularis*. Chasmophytes and cushion plants, such as *Chionocharis bookeri*, occur on rocks.
Tidal forests and mangroves	Sundarbans and the coast of Taninthayi	Sand-dunes are often fringed with, and stabilized by, *Casuarina spp.*

Grasslands or rangelands in South Asia - India in particular - comprise of the tropical savannah, savannah, woodland and dry forest. Grassland diversity includes semi-arid pastures in the Deccan peninsula, humid semi-waterlogged grasslands in the terai in Nepal and India, rolling shola grasslands in the Western Ghats and high altitude alpine pastures in the Himalayas. Indian grasslands harbour an estimated 1,256 species belonging to 245 genera. The great Indian bustard, the lesser florican and the lesser Indian rhinoceros are the key avifauna characteristic of Indian grasslands. Grasslands of the region have great economic value, besides being the providers of food, fodder and habitat for a large number of insects, reptiles, amphibians and birds.

The desert ecosystem in South Asia includes sandy deserts (the Thar desert) in India (2,78,330 sq. km.) and Pakistan; salt deserts in the Rann of Kutch in India (9,000 sq. km.); and the high altitude cold deserts (1,09,990 sq. km.) in Jammu and Kashmir and Himachal Pradesh in India and the alpine reaches of Bhutan. The arid zones in the western parts of India and Pakistan

Source : 1998 UNDP Ecological Co-operation for Biodversity

are home to several faunal species including the desert fox, desert cat, Houbara bustard, chinkara and the great Indian bustard in the Thar desert, and the Asian lesser flamingo, the rare Asiatic wild ass, and crow pheasant in the salt desert. The cold deserts in the eastern Himalayas exhibit high endemism and richness, particularly in the diversity of wild sheep and goat species. The dominant fauna here include the elusive snow leopard, yak, urial, bharal (blue sheep), ibex, Himalayan musk deer, the keong (Tibetan wild ass), snow pigeon, upland pipit and the Tibetan snow finch.

Table 34: Wetlands in S.Asia

Countries	No. of sites	Area (km2)
Bangladesh	12	67,700
Bhutan	5	85
India	137	54,700
Nepal	17	456
Pakistan	48	8,580
Sri Lanka	41	2,740

Source : Scott D.A. and Poole C.M. 1989. A status overview of Asian wetlands no. 53, Asian Wetland Bureau, Kuala Lumpur, Malaysia

Wetlands cover approximately 1,34,261 sq. km. in South Asia, and include floodplains, marshes, estuaries, lagoons, tidal mudflats, reservoirs, rice paddies, saline expanses, freshwater marshes and swamps. In Bangladesh, wetlands cover almost 50 per cent of the total land surface, and are an important source of income and livelihood for several thousands of its people. In Sri Lanka, wetlands account for 15 per cent of the land area.

Wetlands also support specialised biodiversity such as medicinal plant species (for example, *Ghechu aponogeton, Makhana Euryale ferox, Polygonum spp.,* etc.) and several commercial fishes. In Bangladesh alone, more than five million people are dependent on fishing for their livelihood. Of the annual estimated harvest of fish (6,75,000 tonnes) and crustaceans and frogs (7,25,000 tonnes) in Bangladesh, 81 per cent comes from wetlands and rivers while the remaining is from marine sources. In India, the Chilka Lake fisheries in Orissa alone account for more than 700 tonnes of fish per year and are a source of livelihood for people in the coastal region.

Wetlands are also particularly significant as the wintering grounds of several species of waterfowl and migratory birds. Some of the important wetland fauna include the Indian one-horned rhinoceros, marsh crocodile, estuarine crocodile, gharial, the Gangetic dolphin, swamp deer, Manipur brow-antlered deer, Asian lesser flamingo, white-winged wood duck, Andaman grey teal, lesser and greater adjutant stork, bar-headed goose, etc.

Rich and endemic biodiversity of the Himalayas – left to right Bharal (blue sheep), snow pigeon, Himalayan Monal Pheasant and the rare Himalayan Blue Poppy
Source: 1998 Biodiversity Action Plan for Bhutan, Ministry of Agriculture, Royal Government of Bhutan, libray.thinkquest.org; http: www.britannicaindia.com/eb/spotlights/animal/ani04.htm

Magnificient mangroves at Sunderbans

The central Indian ocean marine region includes four South Asian countries - Bangladesh, India, Maldives and Sri Lanka. It comprises of three distinct areas - the Arabian Sea, Bay of Bengal and a large area of the Indian Ocean to the south of India and Sri Lanka. Within the region, India and Sri Lanka (to a lesser extent) are representative of almost all the marine ecosystems - mangroves, coral reefs, sea grass, and estuarine and coastal wetlands. Bangladesh is primarily dominated by estuarine and mangrove ecosystems, while Maldives is made up entirely of coral reefs and atolls.

The Sunderbans, with a total extent of dense tidal forest extending nearly 6,050 sq. km. shared between India (2,000 sq. km.) and Bangladesh (4,050 sq. km.), has the unique distinction of being one of the world's largest contiguous stretches of mangrove forests. Of the 22 countries that hold the world's principal mangroves, Bangladesh and India rank 12th and 14th respectively (Hotdrings and Saenger, 1987). Figures for total area covered by mangroves in the region are extremely variable, but in the northern Bay of Bengal, the Sundarbans and the Ganges delta are estimated to support over 5,00,000 hectares. Besides Sunderbans, important mangrove areas in India are found in the Cauvery and Godavari deltas, Bhitarkanika and the Gulf of Kutch (52,500 hectares) and Andaman and Nicobar islands (1,15,200 hectares); much of the forests in the Andaman and Nicobar are still relatively pristine.

In Sri Lanka, mangroves are found on the north-west coast in the Puttalam Lagoon and the Dutch and Portugal Bay areas.

Maldives has a few small stands, with very low diversity (*Pernetta, 1993d)*. Plant diversity in Indian mangroves is extensive with 45 recorded mangrove species. Sri Lanka has 28 species, Bangladesh has 27, and Maldives about five (*Pernetta, 1993a)*.

Large sea grass beds are present in southern India in the Palk Bay, Gulf of Mannar and the Andaman and Nicobar islands; the estuaries and embankments of Sri Lanka also hold sea grass beds. In Sri Lanka, sea grass covers an area far in excess of that covered by mangroves and coral reefs. Coral reefs, one of the most productive ecosystems, are extensive in the Maldives. The mainland coast of India has two widely separated areas containing reefs – the Gulf of Kutch in the north-west, Palk Bay, Gulf of Mannar (*fringing reefs*), and the Andaman and Nicobar islands. A few coral reefs are also found in Sri Lanka, mainly along the shores. The coastal and marine biodiversity includes about 174 algal species in Sri Lanka, 285 in Maldives and 624 in India (*Perenetta, 1993e*). Over 1,200 species of reef fishes are found in the Indian Ocean around Maldives (UNEP/IUCN 1988). The Sundarbans are an important staging and wintering area for gulls and terns, and the islets of Adam's Bridge, off Sri Lanka, and several atoll islands in Lakhshadweep (Pitti and Baliapani) and in Maldives have seabird colonies.

The coasts of India, Sri Lanka, Maldives and Bangladesh (St Martin's Island) are visited by five of the seven most highly endangered marine turtle species in the world. These are the loggerhead turtle (*Caretta caretta)*, green turtle *(Chelonia mydas*), hawksbill turtle *(Eretmochelys imbricata)*, Olive Ridley turtle *(Lepidochelys olivacea)* and the leatherback turtle *(Dermochelys coriacea*). Marine mammals found in the region include the humpback dolphin (*Sousa chinensis)* and the spotted dolphin *(Stenella attenuata).* The dugong, which is a threatened species in the region, is found in small numbers in the Gulf of Kutch and Andamans and Nicobar islands (Ritchie's Archipelago and North Reef).

Olive Ridley, Green and Hawksbill Turtle – Visitors to the coasts of south asia

South Asia is equally rich in agrobiodiversity and livestock diversity, and has made significant contributions to the rest of the world's supplies of timber, food and medicinal plants, fruits, spices, fibres, oils and dyes over thousands of years. Within the region, India is considered to be one of the world's eight centres of crop plant origin and diversity, as demonstrated by the Russian scientist N.I. Vavilov. The Indian National Bureau of Plant Genetic Resources estimates that at least 166 food/crop species and 320 wild relatives of crops have originated in this region. Some of these include rice, turmeric, ginger, pepper, banana, cardamom, jackfruit, sugarcane, bamboo, taro, indigo, sunhemp, amaranthus, mango and gooseberries.

The Himalayas, a centre of origin of cultivated plants, contain nearly 320 species of wild relatives and related taxa that occur in India. The species richness is concentrated mostly in the western Himalayas and the north-eastern region.

India, Pakistan and Bangladesh account for most of the mangoes produced in the world; India alone accounts for nearly 1,000 mango cultivars. Peninsular India and Andaman and Nicobar islands account for nearly 21 genera and around 91 species of palms. Coconut and arecanut *(Areca catechu)* are cultivated extensively in India and are the major sources of economy for the Lakshadweep islands. Palms are widely used in building, thatching, bag making, fans etc. and the fibres are used for industrial purposes. Nearly 80 per cent of Palmyra palm fibre is exported to Japan and the West.

In Pakistan, the Valley of Kashmir and associated mountains constitute one of the most floristically rich areas. A large number of alpine and sub-alpine species are endemic to the area. Of these, nearly 40 endemics including *Aconitum kashmiricum, Saussurea sacra, Primula minutissima and Megacarpaea bifida* are highly endangered (*Dhara Kachroo 1983 a,b*).

India also has one of the world's largest diversity of domesticated animals, with about 26 breeds of cattle, 40 breeds of sheep, 20 of goats, eight of camels, six

From Left top: Seabuckthorn, Brahmakamal–Saussurea obvallata, a medicinal plant found in the Himalayan region.
Source: Amruth; 1998 UNDP Ecological Co-operation for Biodversity Conservation in the Himalayas ; 1998 Biodiversity Action Plan for Bhutan, Ministry of Agriculture, Royal Government of Bhutan,

of horses, and 18 of poultry, apart from the yak, the mithun, and several species and breeds of birds including geese, ducks, pigeons, and doves *(CSIR, 1970; Mohapatra and Panda, 1981; Khanna, 1993; Sahai, 1993)*.

Finally, within the region, three areas – the Western Ghats in India and Sri Lanka and the Eastern Himalayas (India-Bhutan-Nepal) - have been identified as three of the '18 biodiversity hotspots' *(Myers, 1988)*, areas with high species diversity and high levels of endemism and

Regions in South Asia Identified as Centres of Plant Diversity and Endemism

- Nanda Devi (Kumaon-Garhwal Himalayas, India)
- Northern Sikkim and Eastern Nepal (India, Nepal)
- Namdapha (India)
- Agastyamalai Hills (India)
- Nilgiri Hills (India)
- Nallamalai Hills (India)
- Knuckles (Sri Lanka)
- Kashmir Himalayas (India and Pakistan)
- Peak Wilderness and Horton Plains (Sri Lanka)
- Sinharaja (Sri Lanka)
- Andaman and Nicobar islands (India)
- Sunderbans (Bangladesh, India)

Source: Centre of Plant Diversity, IUCN, 1995

where the species are subject to exceptional levels of threat in the world (see box). Additionally, India is also designated as one of the 12 megadiversity countries *(McNeely, 1990; Mittermeier, 1998; Mittermeier and Werner, 1990)*. These 12 countries alone are estimated to hold up to 70 per cent of the world's species diversity.

5.1 Undervalued and Threatened Biological Wealth

South Asia's enormous diversity and richness of ecosystems has been grossly undervalued. What is known and documented today is estimated to be only a small fraction of the actual (and as yet undiscovered) biodiversity reserves that exist. Moreover, the little that is known today is under severe threat, mainly from anthropogenic pressures for meeting the subsistence needs of the people and from keeping pace with the rapid commercial development sweeping the entire region.

The pressures have, over the years, led to drastic changes in prime biodiversity habitats, resulting in severe habitat loss and degradation in some cases. This has been aggravated by increasing unemployment, poverty, changing lifestyles, lack of awareness and political will, loss of traditional values and vested interests of commercial exploiters – all of which have led to rapid escalation in the plunder of our natural wealth. The untapped, undervalued, fragile biological wealth of the region thus is faced with high risk of extinction in the near future.

Global Biodiversity Hotspots

The Eastern Himalayas, including parts of Nepal, India and Bhutan; the Western Ghats in India (mountain ranges running along west coast of India upto the southern tip); and the Western Ghats in Sri Lanka have the distinction of being designated as three of the 18 biodiversity hotspots in the world.

The mountains of the Western Ghats of south-western India and the highlands of south-western Sri Lanka are separated by 400 km of water, but they are strikingly similar in their geology, climatic patterns and evolutionary history. Representing one of the eight bio-geographical zones of the Indian subcontinent, they are some of the oldest hills on earth and exhibit assemblages of pristine flora and fauna. Two main centres of diversity, the Agastyamalai hills and Silent Valley in the Indian Western Ghats, are home to nearly one-third of all the flowering plants found in India. Of this, nearly 40 per cent is endemic.

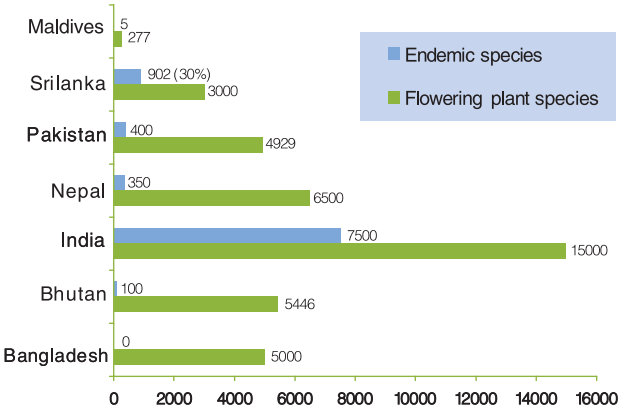
The faunal diversity of the region includes 146 species of amphibians, (116 or 80 per cent are endemic); 259 of reptiles (161 or 62 per cent endemic); 528 of birds (7.5 per cent endemic); and 140 of mammals (38 or 27 per cent endemic). Total number of terrestrial vertebrate species stands at 1,073 (355 or 33 per cent endemic), and of vascular plant species at 4,780 (2,180 or 45 per cent endemic). The fauna includes the tiger, leopard, sloth bear, barking deer, mouse deer, Nilgiri langur, lion-tailed macaque, Nilgiri tahr, spotted deer, giant squirrel, etc. The Indian portion of the Western Ghats is also home to 250 species of orchids, of which 100 are endemic, and 150 species of grasses. The Western Ghats act as the gene bank of mycorrhizal fungi (13,000 species) as well.

The Eastern Ghats too display a rich floral diversity, with about 2,000 species of flowering plants (angiosperms), few gymnosperms such as Cycas and Gnetum Scandens, and 30 species of ferns. The floral diversity in this region is threatened, though some rare plants and trees still survive. Among these are Andrographis beddomei, Andrographis nallamalayana, Dicliptera beddomei, Brachystelma glabrum, Brachystelma volubile, Boswellia ovalifoliolata, Chrysopogon velutinus, Pimpinella tirupatiensis and Cycas beddomei. (Rajamani R., 1998, Conservation of Eastern Ghats – I).

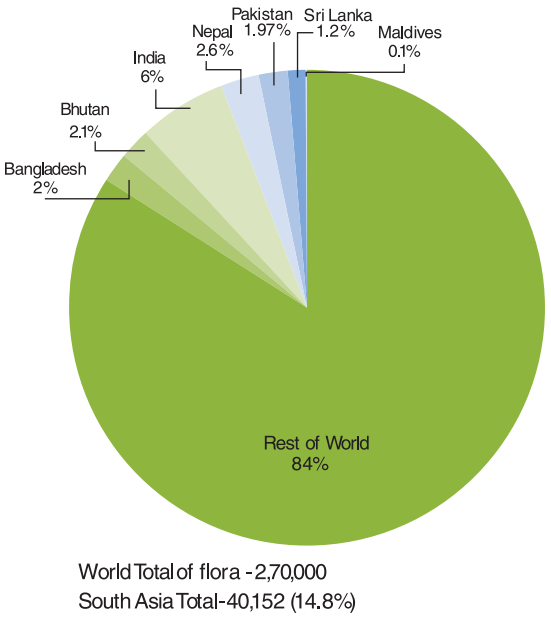
Approximately 18 million people are dependent on resources from the forests in the Western Ghats in Sri Lanka. These forests hold more than 4,700 species of plants, 46 per cent of which are found only in this region. High demand for tree species with commercial value, along with rapid development, has put this hotspot under critical threat of biodiversity loss. Species such as the Indian tiger and the Asian elephant, whose numbers have dwindled due to poaching and loss of habitat, have become important international 'flagships' for tropical forest conservation.

The Eastern Himalayas comprise of tracts of the Darjeeling hills, Sikkim and Arunachal Pradesh in India and eastern Bhutan. Subtropical forests cover the land up to 2,000 m; beyond it lie the temperate mixed forests, mainly comprising of fir, juniper and rhododendron. The eastern Himalayas are home to a large number of endemic fauna including the slow loris, one-horned rhinoceros, golden langur, tiger, Indian civet, red panda, clouded leopard and golden cat. Birds include the snow pigeon, snow cock, white-winged wood duck, pheasants, bar-headed geese and the black-necked crane. The region is particularly rich in endemic plant species. The Indian part of the eastern Himalayas accounts for about 5,800 plant species of which about 2,000 — i.e. 36 per cent — are endemic. In India, Sikkim alone accounts for 4,250 plant species of which 2,550 — i.e. 60 per cent — are endemic. Of the 12,000 plant species found in Nepal and Bhutan, 1,300 are endemic to the eastern Himalayan region.

Floristic Richness and Endemism in South Asia



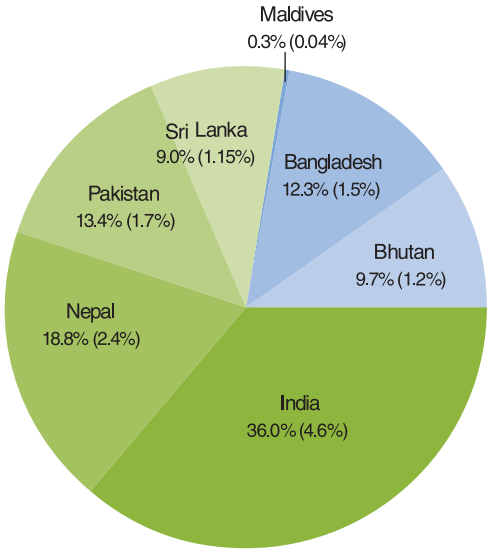
South Asia's Contribution to Global Floral Biodiversity



World Total of flora - 2,70,000
South Asia Total-40,152 (14.8%)

Source:IUCN 1997, Red Data Book of Threatened Plants, World Resources 2000-2001

Faunal Diversity in South Asia



The valuable services provided by the various ecosystems – the mangroves in mitigating the impact of tropical cyclones (a common occurrence in the Bay of Bengal); the wetlands in flood control, water purification and groundwater recharge; livestock biodiversity and agrobiodiversity in providing livelihood, food and shelter; and the marine and forest ecosystems as a major source of food and protein, shelter and livelihoods - have been grossly underrated and taken for granted.

Given these facts, the pressure on the region's biodiversity has been seen to be mainly arising from two major threats – subsistence and commercial. The various factors contributing to these threats and their resultant impacts have been analysed in the following sections.

5.2 Subsistence Threats

Increasing population in almost all countries within the region, particularly India, Sri Lanka, Pakistan, Bangladesh and Nepal, and the resulting increase in demand for food, shelter, energy and fuel and fodder to meet their basic subsistence needs have put tremendous pressure on the different natural ecosystems that exist within the region. Traditional sustainable practices have been altered, giving way to a new culture of 'fast returns' in the form of monocultures with serious consequences in the future.

Table 35: Faunal Diversity in South Asia

	Mammals	Birds	Reptiles	Amphibian	Fishes
Bangladesh	109	295	119	19	260
Bhutan	99	448	19	24	44
India	316	926	137	209	748
Nepal	281	611	100	43	185
Pakistan	151	375	172	17	156
Sri Lanka	88	250	144	39	65
Maldives	0	23	0	0	0
South Asia	1,044	2,928	691	351	1,458
World	4,629	9,672	6,900	4,522	25,000

Source :
1. IUCN Red Data Book of Animals 1996
2. WCMC Database, 1998 World Resources 200-2001

Agriculture and Forests

Agriculture is the main source of livelihood for a majority of the region's rural population. In the last 10 years, the per capita land availability in the region has reduced by 18.4 per cent and now remains a meagre 0.16 ha. The reduction is attributed to the rapid increase in population and consequent fragmentation of the land.

Similarly, per capita cereal availability has also reduced by 9.4 per cent in the last 10 years. The present per capita cereal availability is only 0.16 kg, thus making it very important to ensure food security in the region at any cost. Agricultural productivity in the region is not adequate to produce sufficiently for the increasing population. The average agricultural yield at present is 2.1 tonnes/ha (excluding Maldives) after an increase of 8.1 per cent in the last 10 years. The increase is attributed to increased use of fertilisers (69 kg/ha, which is a 40 per cent increase in the last 10 years in the region, excluding Maldives) and inclusion of more area from forests into the agriculture sector. This situation has, in its turn, taken its toll by depleting and threatening the remaining biodiversity of the region.

Forests play a vital role in the economy of developing countries. A large segment of South Asia's population depends on forests for its housing, fuelwood and fodder needs. The demand for forest products and services is increasing with the growth in population and economy, even as the forest cover in the region deteriorates. A disproportionate withdrawal of forest produce as compared to a forest's carrying capacity leads to this deterioration. Between 1990 and 1995, five countries in the region have experienced a reduction in their forest cover; the exception has been India where forest cover has increased by 36,000 ha. This increase can be attributed to an increase in commercial plantation and wasteland reclamation activities.

Plantations:

In order to cater to the increasing demand for fuelwood, fodder and timber, the area under commercial plantations has increased in five countries of the region (Bangladesh, Bhutan, India, Nepal and Pakistan) between 1990 and 1995. Forestry has been accepted as a farming practice, but has not spread in the region at the desired pace because the rotation cycle of forestry plantations takes time to give returns. It, therefore, has become limited to the bigger farmers. The slow-growing indigenous tree species have not been preferred in the commercial plantations, resulting in the introduction of fast-growing exotic tree species, which in turn has changed the composition of the local vegetation to some extent.

Plantation forestry has resulted in large-scale monocultures of teak, sal, eucalyptus, Mexican pine, etc. The yield and income data collected from different countries have influenced the developing countries to adopt these species. This has been complemented by the indiscriminate plantation of eucalyptus, even on very dry sites where other species can perform better.

Table 36: Extent of Cropland (000 ha)

	Bangladesh	Bhutan	India	Nepal	Pakistan	Srilanka
1987	9248	130	169770	2968	20920	1895
1997	8241	160	169850	2968	21600	1888
Increase	1007**	30*	80*	Nil	680*	7**

Source: World Resource 2000-2001 * *indicates increase* ** *indicates reduction*

Table 37: Change inForest Cover (000ha)

	Bangladesh	Bhutan	India	Nepal	Pakistan	Srilanka
1990	1054	2803	64969	5096	2023	1897
1995	1010	2756	65005	4822	1748	1796
Change	44**	47**	36*	274**	275**	101**

Source: World Resource 2000-2001 * *indicates increase in forest cover* ** *indicates reduction in forest cover*

Table 38: Plantations (000ha)

	Bangladesh	Bhutan	India	Nepal	Pakistan	Sri lanka
1990	235	4	13230	56	168	139
1995	443	12	20252	140	840	138
Increase	208*	8*	7022*	84*	672*	1**

Source: World Resource 2000-2001 * *indicate increase* ** *indicate reduction*

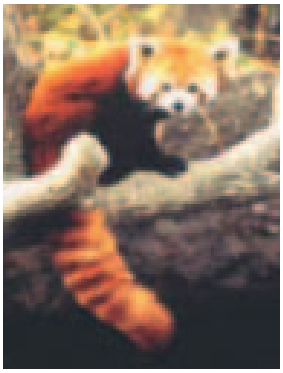
Shifting cultivation:

Commonly practised by the hill tribes of India, Nepal, Pakistan and Sri Lanka, shifting cultivation is considered to be a major cause of deforestation. It is difficult to estimate the exact extent of shifting cultivation in the region due to the dispersed and unorganised nature of the activity, however it is estimated that it is practised over an area of 63.57 million hectares by about 22.7 million people in Bangladesh, India and Sri Lanka (*State of Environment in Asia and Pacific, 1990*).

In India alone, shifting cultivation is reported to be practised on 4.37 million hectares, and in Bangladesh about 8,00,000 people depend on shifting cultivation in the northern and eastern hills, where land degradation rates are quite high (SAARC, 1992). According to the Forest Survey of India, an important cause of habitat destruction in the eastern Himalayan states of Sikkim and Arunachal Pradesh is slash-and-burn/shifting cultivation practised in nearly 70 per cent of the land area, which has resulted in the loss of nearly 57 per cent of forests in the area. However, it is not the practice itself that is faulty; the growing population pressure has led to a shortening of the fallow cycle, thus not allowing sufficient time for forest resources to regenerate, which has resulted in this practice becoming unsustainable.

Livestock grazing:

Forest grazing is also a major factor in the deforestation process. In the region's drier parts, forest grazing is traditional and endemic to agricultural lifestyles. This problem is acute in large parts of India, which suffers from a lack of adequate grazing lands and a mammoth livestock population. Forests, therefore, are the only places where livestock can find any vegetation. Occupying a little over 2.4 per cent of the global land area and 16 per cent of the human population, India accounts for nearly 20 per cent of the world's livestock population. The nation's 12 million hectares of permanent pastures are grossly inadequate for the needs of its 1,896 million heads of cattle. This large livestock population has put tremendous pressure on land, particularly the grasslands.



Red Panda – Threatened and endangered due to habitat loss, deforestation and poaching
Source: www.animal.info.org

Not only are rangelands damaged by grazing practices, but forests also suffer livestock pressure as branches are cut for fodder or entire stands are levelled to make way for pastures. In Nepal, lopping is a prevalent practice, with nearly 40 per cent of the buffalo feed and 25 per cent of cattle feed is made of logs and leaves, thus putting tremendous pressure on the forests.

Besides overgrazing by livestock, conversion to croplands is also a major threat to natural grassland ecosystems and results in decreasing vegetation and exposes the soil to water and wind erosion. In addition, livestock trampling compacts the soil, reducing its capacity to retain moisture. This is estimated to affect 280 million hectares in the region (33 per cent of the total degraded land).

Propagation of monocultures:

Being a primarily agrarian region, agriculture practised over several thousands of years has led to the building up of a complex gene pool of thousands of crop plants adapted to local conditions. The traditional practice of planting several different varieties of crops in different seasons in an area, was intended to minimise risks from crop failure. However, the past years have witnessed the introduction of monocultures of fast- and high-yield crop varieties and livestock to increase productivity.

A view of mono culture, destroying habital
Source: Bangladesh:State of the Environment 2001

Introduction of monocultures has resulted in genetic erosion of domesticated species of plants, animals and fishes. Thousands of varieties of rice, millets, oilseeds, vegetables and legumes have been lost and several breeds of domesticated animals and birds are threatened. The number of threatened breeds include three breeds of cattle, seven of sheep, five of goats, five of camels, four of horses and all breeds of poultry.

It is estimated that until recently, for the past 50 years, Indian farmers were growing nearly 30,000 varieties of rice. However, *Maheshwari (1986)* predicts that by

Humans vs Animals

An emerging impact of the increasing pressure of loss of prime wildlife habitats due to subsistence threats is increasing instances of human-animal conflict. One such conflict which is increasingly becoming common in India is between man and one of his closest wild associates, the elephant. Elephants play a crucial role in maintaining forest biodiversity and their presence is indicative of the "richness of biodiversity" and the "good state of forests, water regions and soil conditions" of the area. A habitat preferred and inhabited by elephants is also considered good for other species such as the sambhar, cheetal, panther and tiger.

The conversion of forests to croplands following drastic changes in agriculture and forest policies, and the propagation of monocultures has led to a severe loss of elephant habitat across the country. This has forced the gentle beasts to come out of the dwindling forests in search for food and raid the nearby agricultural fields – thus laying the foundation for these conflicts.

Studies conducted by the Wildlife Institute of India reveal severe scarcity of elephant habitats in several states. Conversion of natural forests to commercial timber or other monoculture plantations has drastically reduced these habitats. Between 1976-96, nearly one-third of the elephants' habitat was replaced by eucalyptus and other quick-growing species. Similarly, the conversion of sal forests to teak plantations has also adversely affected elephant habitats.

In the north-eastern state of Arunachal Pradesh (India), the elephant's habitat is shrinking due to the construction of roads, development activities, and increasing human settlements in the foothills and valleys. The adjacent states of Meghalaya, Nagaland and Tripura are reported to have already lost nearly 25-40 per cent of their forests, a major cause of which is the practice of slash-and-burn agriculture. Faulty policies and agricultural practices have put two species that had lived in harmony, into serious confrontation.

A similar scenario afflicts the rare Indian rhinoceros. The need for increased land by a growing human population has posed a serious threat to its habitats – and its survival. Several protected areas that have rhino populations have reached their carrying capacity, thus leading to increased conflicts between man and rhinos who reportedly raid rice fields outside the parks.

the year 2000 this is expected to reduce to 50 varieties and according to a recent estimate by *Ryan (1992)*, by 2005, India is expected to produce 75 per cent of its rice from just 10 varieties. This is expected to drastically reduce the genetic diversity of staple food crops, posing serious consequences not only for the future plant breeding programmes, but also for meeting the food requirements of the burgeoning population.

Fuelwood and fodder extraction:

In India, nearly 90 per cent of cooking fuel is biomass-based (fuelwood, cowdung and crop waste). The average annual requirement of cooking fuel in the country is 130 million tonnes, and more than 80 per cent of the fuelwood is collected from the countryside. Increased fuelwood needs have been resulting in increased deforestation to the extent that some sacred groves, which were left untouched for several years, have been damaged or cut down (*Gadgil & Vartak 1975, 1976)*. In Nepal, nearly 90 per cent of all the energy consumed is still in the form of traditional fuel (WRI, UNEP, UNDP, WB, 1995). Biomass fuel comprises 73 per cent of the total energy consumed in Bangladesh.

These subsistence threats have, over the years, led to deforestation and loss of prime habitats of biodiversity. Loss of tree cover has led to erosion, landslides, silting of rivers and dams and floods downstream, resulting in economic losses. This has put to threat the existence of several species. Introduction of fast-growing monocultures has resulted in genetic erosion and loss of germplasm for evolution.

5.3 Commercial Threats

The past decade in South Asia has been witness to rapid commercial developments with diversification in urbanisation and industrialisation. There has been an unprecedented spurt in development activities with very little regard for the environment and biological wealth. The increasing demand for and commercial value of the region's biological wealth in markets outside the region has led to increased illegal poaching and trade in biodiversity.

Urbanisation and Industrialisation

In 1980, the rate of deforestation in South Asia was about 1.7 million ha/annum. The rate of deforestation is analysed by comparing absolute figures of deforestation with the population figures. The current

annual rate of deforestation in South Asia is about $3m^2$/ person. This is due to high populations, limited forest resources, construction of irrigation and hydroelectric projects, mining activities, land settlement programmes and road construction.

The annual demand for industrial wood in the region is about 28 million cubic metre (mm3) against a production capacity of 12 mm3. This naturally has serious consequences for the forests in the region. The countries experiencing the fastest deforestation in the region are Bangladesh and Pakistan. Bangladesh, one of the most densely populated areas in the world, has recorded 94 per cent loss of original wildlife habitat. In Sri Lanka, during 1956, the total area under forests was about 44 per cent of the total land area; in 1983, it came down to 26.6 per cent and in 1992, the forest cover stood at 20.2 per cent. Deforestation resulting from construction of irrigation and hydroelectric projects is also a major problem, especially in Sri Lanka and India. Almost 2.4 million sq. km. have been lost to deforestation in India.

Mining:

In Sri Lanka, mining for precious gemstones poses serious threats to Peak Wilderness and Horton Plains *(Hoffmann, 1988)*. A sizeable area of natural forests near Peak Wilderness is reportedly extensively damaged by soil erosion as a result of mining for precious stones. There is also extensive mining for monazite, ilmenite, rutile, garnet and zircon along the Tamil Nadu coast in India. It is estimated that there are some 2,000 million tonnes of pure calcareous sand available in the lagoons of Lakshadweep which could be suitable for a number of industrial purposes *(Qasim and Sankaranarayan, 1970)*.

Marine pollution:

This is a problem common to the region resulting in degradation of coastal areas and resources. The main route of marine transport of oil from the Gulf is across the Arabian Sea, where it passes the southern tip of Sri Lanka across southern Bay of Bengal, through the Malacca Strait to the Far East and Japan. The sea lane in the southern coast of Sri Lanka carries an annual volume of over 5,000 tankers in ballast or loaded conditions. Dondra Head in the southern tip of Sri Lanka serves as a focal point for ocean transport before ships change course for onward passage.

This shipping of oil, coupled with increasing emphasis on offshore oil exploration in many countries of the region, makes the northern Indian Ocean vulnerable to oil pollution. In addition, effluents from land-based sources (such as refineries) and harbour activities also

A victim of oil slick
Source: Hindu Survey of the Environment, 1993

add to the pollution. Internal movements of fuel and its decentralised storage for supplying the fishing fleet pose a potential risk of future oil spills and accidents. In the port of Chittagong in Bangladesh, for instance, nearly 1,000 ships and over 40 oil tankers are handled annually, while the port of Mongla services nearly 500 ships. The estimate of crude oil spillage in Chittagong is about 6,000 tonnes annually, while crude oil residue and waste water effluents from the refineries amount to about 50,000 tonnes per year *(Khan, 1993)*.

Industrial effluents and sediments:

In recent years, industrial effluent discharges have become a major source of land and water pollution in the region. Effluent discharge from the textile dyeing and printing industries into the ephemeral streams have contaminated the surface and groundwater downstream. Use of such toxic water for irrigation has also degraded the land. It has been reported that beach tar along the west coast of India is now a severe problem, with total deposits of up to 1,000 tonnes per year *(GESAMP, 1991)*. Considerable damage has been noted on some of the Indian atolls and coral reefs of the Andaman and Nicobar islands. In Pakistan, mortality among flora in the harbour of Karachi and the tainting of commercial edible shellfish have also been reported. The presence of toxic heavy metals such as mercury, cadmium and lead, has also been detected in the seas and coastal waters of the region.

The amount of sediment in the coastal areas of the South Asian region is high, mainly due to soil erosion. Annually, about 1.6 billion tonnes of sediments reach the Indian Ocean from rivers flowing from the Indian subcontinent. The total annual sediment load of the river system of Bangladesh alone amounts to about 2.5 billion tonnes, of which the Brahmaputra carries 1.7 billion tonnes and the Ganga, 0.8 billion tonnes (*UNEP, 1987*).

Tourism:

Increased tourism continues to be a source of pressure on coastal resources. In fact, coastal tourism is recognised as the most rapidly growing sector of tourism world-wide. In Sri Lanka, between 1970 and 1990, tourism grew by nearly 300 per cent and is expected to increase by another 50 per cent by the end of the century. Sri Lanka's coastal resources are expected to come under increasing threat from this economic sector. Marine-based tourism is on a dramatic rise in the Maldives as well. It contributes to more than 19 per cent of the country's GDP and nearly 30 per cent of the government revenues *(Government of Maldives, 1998)*. It poses a serious threat of environmental degradation, particularly through construction of hotels, beach clubs and marinas which involves infilling and dredging.

Visitor pressures pose a threat to some fragile areas in the Horton Plains in Sri Lanka - especially to a number of rare grassland species. The number of visitors to Adam's Peak has increased dramatically over the last four-five decades. Pressure from tourism has led to degradation of forests, changes in density and composition of species, and a loss of rare plants.

In Sikkim (north-east India), a biodivesity hotspot, unplanned domestic tourism is adversely affecting the biodiversity of the region. Tourists invade ecologically fragile areas such as alpine grasslands, trample and uproot plants, leaving a trail of destruction behind them. Hotels and lodges in the state consume about 40 kg/day of oak, mahua and rhododendron bushes for firewood. In several areas in Sikkim, felling of fir trees for construction of hotels and lodges has resulted in accelerated erosion. The growth of trek tourism has resulted in the use of pack animals like yak, which consume nearly 30 kg of fodder - which puts further strain on the forests.

Unsustainable Fishing Practices

Increasing population pressures and rising demands for fish and other marine resources have resulted in the introduction of modern fishing methods and technologies, which have completely transformed the industry in the region. Marine catches in South Asia have recorded a constant increase indicating that the maximum exploitation levels have not yet been reached. However, the increased mechanisation and destructive techniques of fishing pose a serious concern and threat to the marine biodiversity of the region.

In the Maldives, while there is no evidence that exploitation of the tuna fisheries is exceeding the sustainable yields, the potential for this to happen in the future is great. Tuna fishing is carried out by traditional motorised dhonis which are dolphin-friendly. The catch in all sectors of the fin fisheries have increased, but there is no indication yet that the maximum sustainable yield has been reached. There are, however, some indications of local over-exploitation of reef fishes in Malé atoll, and populations of giant clams, sea cucumbers and lobsters have reportedly declined due to intensive fishing.

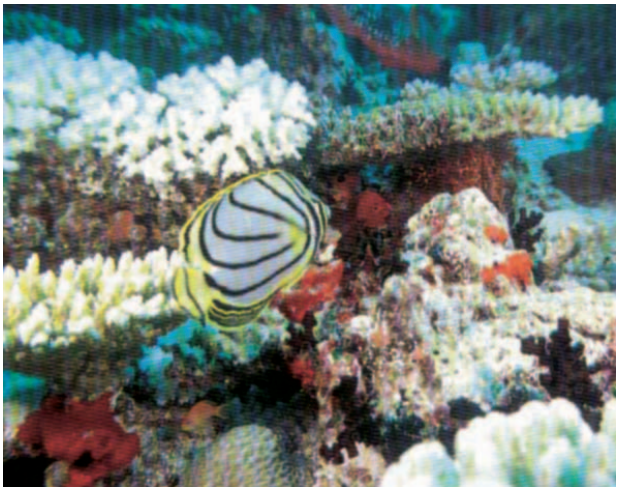
In Sri Lanka, the use of motorised crafts with insulated fish hold facilities for increased catches is reported to have resulted in threat to some species of dolphins. Fishing by local and foreign trawlers using bottom-set nets and long drift nets is reported to have had adverse effects on the marine biodiversity *(Biodiversity Conservation in Sri Lanka, Framework for Action, Ministry of Forestry and Environment, 1998)*. Traditional fishing using non-motorised crafts (dugout canoes and catamarans) and techniques such as angling, fill netting (natural fibre nets) and beach seining have received a setback due to depletion of shore fish resources and competition from mechanised crafts.

Besides fish, lobster resources in Sri Lanka's southern coast have depleted due to indiscriminate harvesting of gravid females and juveniles. There is extensive collection and harvesting of lobsters and crabs (in 1998, it was 164 and 486 metric tonnes respectively) inspite of a ban on their collection. The export trade in ornamental fish ranks next to that of prawns and lobsters in terms of value and levels of collection for sale and export. Nearly 200-300 species of fish and invertebrates are being exported by Sri Lanka for the aquarium trade.

Seven of the 20 edible species of sea cucumbers (*Holothuria*) found in the Indian Ocean are present in Sri Lankan waters. Till recently, traditional harvesting was limited to the estuarine environment; but to meet the increasing demand, sea cucumbers are being harvested unsustainably in large numbers. Export figures have recorded a decline from 272 metric tonnes in 1997 to 203 metric tonnes in 1998 *(Joseph, 1993; Brown, 1997)*. Sea cucumber *(beche-ce-mer)* catches are entirely exported to Singapore and Hong Kong. The decline is attributed to the declining population in the region.

Coral destruction:

Most coral reefs in the region are under increasing threat and have been degraded due to causes such as coral mining, fishing with explosives, sedimentation, pollution, removal of reef organisms, anchoring, harbour construction and removal of coral for curio trade. However, the latest threat to these reefs is reported to be from the increasing temperatures of the oceans (see box).



Coral Reefs under threat

Coral mining is a major concern in the Maldives where, due to severe shortage of construction material, there is no option but to resort to coral mining; coral rock constitutes the main building material. It is estimated that nearly 94,000 cu. m. of rock was mined in Maldives between 1975-1985. Recent estimates are between 2,00,000 and 1,00,000 cu. m. of coral rock annually *(Rajasuriya, Arjan and White, Alan: Status of Coral Reefs of the World, 1998).*

Tourism is a major source of income for the Maldivian economy. It also incorporates extensive reef-related activity; tourist resorts in the area have expanded from two in 1972 to 74 today. Besides this, corals also face natural threats which include the large populations of the Crown-of-thorns starfish, which causes considerable damage to reefs around Sri Lanka, Maldives and India. *(D. Bruin, 1972; Rajasuriya and Rathnapriya, 1994).* In Sri Lanka, however, most known reefs - particularly the readily accessible near-shore reefs - have been degraded due to human-induced damage *(Ekratne, 1990b, 1997c).*

Aquaculture:

Mangroves and associated lagoons and estuaries which are productive ecosystems, function as nurseries for several species. Loss of coastal habitats includes substantial loss of mangrove forests in South Asia, particularly for making way for the construction of shrimp ponds and for paddy rice cultivation, with negative impacts on commercial fisheries that rely on species using the mangroves as nursery areas. Fish and shellfish have suffered due to reduced water quality, clearance of mangroves for prawn farming and shrimp ponds and also the wide use of chemicals in prawn and shrimp farming. Prawn farming has cleared

Table 39: Threats to South Asian reefs

	Erosion/ Pond clearance	**Construction**	**Pollution**	**Over collection**	**Recreational** use	**Fishing** Activities
Bangladesh			Sewage* industrial *	shells, corals	tourism	Dynamiting
India agriculture	Deforestation, mining	Coral & sand industry* Sewage	Oil,	Trochus particularly in Andaman & Nicobar Island	Tourism*	Dynamiting
Maldives	infilling, dredging, coral mining	Hotels, airport, Shipping, Sewage	Industrial* corals	Shells, fish, Divers* Collection for aquaria	Anchor damage dynamiting	Spearfishing
Sri Lanka		Coral mining	Coconut soaking	Fish, corals, shells, reef fishes to meet demands of tourism	Tourism collection for aquaria spear fishing.	Anchor, damage dynamiting,

Source: UNEP/IUCN (1988). Coral Reefs of the world Vol. 2. Indian Ocean, Red Sea & Government.

** Potential threat . The 1998 Coral bleaching event mainly attributed to increase in ocean temperatures has seriously affected the reefs of this region with nearly 60.80per cent losses reported.*

ecologically sensitive mangrove areas (359.5 ha) that were incompatible with shrimp farming, which boomed in 1983-1992 (*Jayasinghe, 1995*).

Identical problems because of shrimp culture have occurred in Bangladesh, India, and Sri Lanka. One example of this destructive sequence of events is the Chakaria Sunderbans in eastern Bangladesh, which has been almost completely cleared for aquaculture (*ESCAP, 1995a*).

There are also reports of reduced water quality, salinisation of paddy yields and reduced rice yields (50 per cent) due to tiger prawn farming activities in the area – mostly the results of land-fill and reclamation activities for housing and infrastructure.

Wetlans of Bangladesh
Source: Bangladesh Centre for Advanced Studies

Consumerism and Increasing Market Demand

In the past few years, the region has witnessed rapid escalation in incidents of poaching, trading and smuggling of wild flora and fauna due to increased demand and commercial value of wildlife and their parts. This demand is largely from other parts of the world. Loss of traditional values, lack of knowledge and awareness, and poverty and unemployment have led to mercenaries and middlemen exploiting people for their services in this lucrative and insensitive trade.

Illegal trade in fauna and flora:

South Asia - and India in particular - has been the focus of international attention due to the drastic fall in the

Sunderbans: Threatened Home of a Threatened Species

Sunderban, meaning the 'beautiful forests', derives its name from the predominant tree - *Heriteria fomes,* locally called the 'Sundari' tree. It is one of the world's largest contiguous patches of mangrove forest, extending up to 10,000 sq. km., of which 4,262 sq. km. lies in southern West Bengal (India) and the remaining greater part extends into Bangladesh. It is representative of the Indo-Pacific type of mangrove flora in the subcontinent, and the only mangrove habitat in the world with a tiger population.

The Sunderbans exhibit three district ecological zones and hold about 25 species of forest flora of which the Sundari, Gewa (*Excoecaria agallocha*), Goran (*Ceriops decandra*) and Keora (*Sonneratia apatala*) are predominant.

These mangroves support a wide range of mammals, birds, amphibians, reptiles and crustaceans. Some famous residents of Sunderbans include the Royal Bengal tiger, estuarine crocodile, spotted deer, Indian wild boar, fishing cat, monitor lizard and nearly 300 species of birds. The aquatic fauna includes more than 250 species of fish, prawns and crabs. Several endangered turtles (*Lepidochelys olivaceae*), terrapins (*Trionyx gangeticus, Batagur baska,* etc) and the Gangetic dolphin (*Platanista gangetica*) are found here. Crustaceans, found in abundance, account for nearly 40,000 tonnes of fiddler crabs, 1,00,000 tonnes of mud crabs, and large quantities of shrimps, prawns and lobsters.

The biological richness of this region has been a source of employment and livelihood for nearly 5,00,000 people living in its vicinity. These forests have been under some kind of management for commercial exploitation of resources. However, over the years the increasing population and its increasing dependence on this ecosystem have led to its unsustainable exploitation. The Sundari trees have suffered a nearly 45 per cent reduction. Sundari trees are harvested mainly for timber while Gewa is used as pulpwood in newsprint mills and as matchwood, and Goran is felled for fuelwood. Most of the key species have recorded a decrease in numbers over the last 20 years.

The unsustaniable exploitation has caused considerable stress on this fragile ecosystem resulting in nearly four major species - the Javan rhinoceros, wild buffalo, swamp deer and the hog deer - becoming extinct. The famous threatened resident, the Royal Bengal tiger, is also increasingly getting rarer along with the estuarine crocodile and deer. It is feared that this continued exploitation would not only affect the ecology of the ecosystem in the near future, but also have severe adverse impacts on its economic viability as a source of livelihood.

Wildlife : tiger
Source: Bhutan:State of the Environment 2001

population of the Bengal Tiger (*Panthera tigris tigris*) as a consequence of indiscriminate poaching and killing for meeting the increasing market demand for tiger parts in Oriental medicine.

Besides the tiger, the illegal trade in faunal products include some of the most endangered species - the rhinoceros, musk deer, bear, elephant, the falcon and other birds such as parakeets. Trade in wildlife and its parts in the region is reported to be next only in volume to the trade in narcotics and illegal arms.

Falcons are smuggled to West Asia from India and Pakistan. In Pakistan, lizards and snakes are killed for their skins and crocodile hunting is a popular sport and recreational activity (*Government of Pakistan, 1994: Pakistan Conservation Strategy*). Rhino horns are used extensively for ornamental items such as handles for daggers etc. in Nepal, and tigers and leopards are killed for their skins and bones.

Medicinal plants, over-exploitation and biopiracy: The South Asian countries hold immense reserves of medicinal plants and trade in medicinal plants is widespread. It is estimated that this trade, between developed and developing nations, would touch an all time high of US $500 billion by the end of 2,000 and the value of germplasm from developing countries to the pharmaceutical industry would be around US $47,000 million by the turn of this century.

At least 90 per cent of the plant species used in the industry are collected from the wild. A 1997 World Bank report says that revenue earned by India from the export of crude herbal drugs in 1994-95 was $53.2 million (Rs. 197 crore). Medicinal plants-related trade in India is worth Rs. 550 crore; Rs. 900 crore worth of herbal medicines are produced annually in India. Over 7,000 licensed manufacturers supply 55,000 pharmacies and 14,000 herbal dispensaries with plant-based products. Nearly 300 million Indians still use medicinal plants and herbs for primary health care. Around one million village healers treat local communities in various parts of India. While Ayurveda, Siddha and Unani together use at least 1,200 medicinal plants, tribals as well as rural communities use over 6,000 medicinal plants for treating a variety of ailments. In the Indian subcontinent, approximately 1,000 species are used in food and forage, and about 7,000 species in indigenous folk medicine. In India, nearly 800 natives plants are used (*Kaul et al, 1990*).

Several species of plants are threatened with extinction due to commercial over-exploitation in India and Nepal. Some of these are *Coptis teeta*, *Rheum nobile* and *Rheum emodi,* and several species of orchids, etc. Commercial export of medicinal plants and their products in Nepal has resulted in a dramatic rise in Nepal's foreign earnings.

Tibet's Medicinal Resources

According to Dr. Tenzin Choedak, senior personal physician to His Holiness the Dalai Lama, there are over 2,000 medicinal plants in Tibet. These plants have an immense potential to cure various dreaded and common ailments. For example, *Taxus wallichiana*, a tree found in the forests of Tibet, is the source of the allopathic drug taxol, which is regarded as one of the most effective remedies for cancer. The Tibetan plateau is rich in such medicinal plants, which are widely used in allopathic, homeopathic, Tibetan and Chinese medicines. Some of these are *Gastroda elata, Angelica sinensis, Coptis tectoides, Picrorhiza scrophulariiflora, Rheum officinalis, Magnolia officinalis, Terminalia chebula,* and *Liolyophora phalloides.*

The richness of the plateau has been exploited and damaged by unregulated extraction of its resources. For example, in the six years from 1987 to 1992, in the region of Amdo Golok in eastern Tibet alone, medicinal plants worth several hundred tonnes had been extracted. Among those taken out were *Rheum palmatum* (chumtsa) - 1,017.5 tonnes; *Frittilaria sp.* (abhika) - over 30 tonnes; *Cordyceps sinensis* (Yartsa gunbu) 9,105 kg; and the *Gentiana robusta* (Kiche) - 36 tonnes. In 30 years, 6,105 tonnes of chumtsa, 180 tonnes of abhika, 54.9 tonnes of Yartsa gunbu, and 28.5 tonnes of deer antlers have been extracted.

Source: www.tibet.com/Eco/Green97/biodiversity.html

An aspect of the whole issue is that the over-exploitation is not only leading to economic loss, but also to biodiversity loss. This is because most companies, after plundering one area, look for greener pastures.

Patenting:

Most of the biodiversity is found in the Third World countries and in communities living in remote areas. There are several instances of germplasm being extracted from biodiversity-rich countries and the subsequent patenting of products based on these genes for commercial gains. Local communities who have been traditionally using these plants and animal varieties for their sustenance over several generations for centuries, have been deprived of the right to their own resources due to patenting.

Illegal Exploitation of and Trade in Medicinal Plants

- *Rauwalfia serpentina,* a herb used in the treatment of high blood pressure, is on the verge of extinction due to overexploitation for commercial purposes.
- The entire plant of Daru haldi (*Berberis aristaka)* is uprooted for extracting berberine which is used in preparing eye medicines.
- *Coleus forskohlic* is a medicinal plant which has been traditionally used to cure cardiovascular diseases, abdominal colic, insomnia, etc. Hoechst has taken six patents covering uses for compounds extracted from this plant.
- *Taxas bacatta*, known locally as Rakha, found in Himachal Pradesh, has properties of curing cancer. Researchers in the West use Taxol, its by-product, in the manufacture of anti-cancer medicines. Its roots are uprooted, thus causing soil erosion.
- In Garhwal and Kumaon, a private firm has been involved in indiscriminate illegal trade of genetic materials.
- In the Western Ghats, the Americans and British nationals posing themselves as tourists, are collecting samples of plants, soils and insects. They take all these back home to study.
- In Arunachal Pradesh, India, some companies have offered Rs 300/kg to collect *Coptis teeta,* commonly known as Mishmitita, which cures malaria. Local people are enticed by these companies to overexploit this plant.
- Tetu Lakda (*Nothatodytes foetida*), a tree found in the forests of southern India, is facing a threat from traders for its use in the treatment of cancer. Twigs of this tree are available for just Rs 9 per kg. However, after being processed, the extract is sold by pharmaceutical companies for $15,000 per kg.

5.4 Other Threats

Alien Invasive Species

Introduction of exotic flora and fauna is an increasing threat to the endemic biodiversity of South Asia. Some of these introductions in the region - some consciously and some due to oversight - are the acacia, eucalyptus, lantana, etc. Invasive species have flexible habitat requirements; most of them are extremely aggressive and quickly establish themselves as the dominant species.

In Bangladesh, invasive floral and faunal species have been intentionally introduced for increasing productivity. Two controversial genera of flora introduced to the country are the acacia and eucalyptus, which exercise adverse effects on soil fertility, water, the humus-dependent species and terrestrial wildlife. There are also several species of invasive fish, the most 'disastrous' being *Clarias gariepinus, Pangasius giganticus, Tilapia mossambica and Oreochomis niloticus*. Bangladesh has a high fish diversity due to its extensive wetlands, but indiscriminately introduced invasive species have spread rapidly during severe floods, posing a threat to the indigenous fauna. As a result, 54 indigenous fish species are now threatened with extinction in the country. Some invasive fish species are predators of indigenous aquatic fauna, and the *Tilapia mossambica* and *Oreochromis nitrous* compete with indigenous fish species and occupy their niches.

Bleaching of corals in Maldives
Source : www.noaa.gov

In Sri Lanka, several alien plants, including *Salvinia molesta, Eichhornia crassipes, Lantana camara, Mimosa pigra, Opuntia stricta, Lantana camara, Eupatorium riparium* and *Myrosylon balasmum* have been reported to have spread at alarming rates. Invasive fauna in the country include six species of freshwater fish (*Oncorhynchus, Sarotherodon mossambicu, Trichogaster pectoralis, Poecilia reticulate, Chitala chitala* and *Hypostomus plecostomus*), two species of snails (*Achatina fulica* and *Pomacea spp.*) and two species of mammals (*Rattus rattus* and *Bubalus bubalis*).

In India and Pakistan, exotics account for up to 40 per cent of the flora. In Pakistan (Sind) the figures are higher. The exotic plants are mainly from South America or Mexico. *Eupatorium adenophorum* (in north-eastern India) and *Parthenium hysterophorus* (in the south Indian plains) are the two most invasive species in the Indian subcontinent. *Eichhornia crassipes* is an alien invader of the water bodies.

Disasters and Episodic Events

The South Asian region is prone to natural catastrophes and episodic events such as cyclones, earthquakes, floods, etc. which wash away the topsoil, thus directly affecting the floral vegetation. The recent years have been witness to an unprecedented warming of the oceans, particularly around the Indian Ocean, due to El Nino. This has adversely impacted on the region's coral reefs, a fragile ecosystem (*see box*).

The impact of all the above threats, arising from subsistence and commercial pressures, have resulted in an adverse impact on the biodiversity of the region. The past few decades has already witnessed the extinction of the Javan rhinoceros from India and Bangladesh, and 23 other species including the cheetah and the pink-headed duck are fast disappearing from India. According to the 2000 IUCN Red List, India ranks second in the world with the largest number (80 species) of threatened mammals; Sri Lanka ranks third, next only to Indonesia and Brazil, with 280 species of threatened plants.

Responses

Inspite of the serious threats and the resulting impact as analysed in the preceeding sections, South Asia is still home to nearly 15 per cent of the world's floral and 12 per cent of its faunal biodiversity. This can be attributed to the fact that several countries within the

The Vanishing Ocean Rainforests

Coral reefs, often referred to as the "rainforests of the oceans" are a critical global resource, both biologically and in socio-economic terms. Besides being home to an estimated one million different species, they are a major source of food for coastal communities and are the basis for a huge tourism industry, providing both livelihood and foreign exchange earnings. They are also the sources of medicines and are considered as one of the most productive ecosystems on the earth.

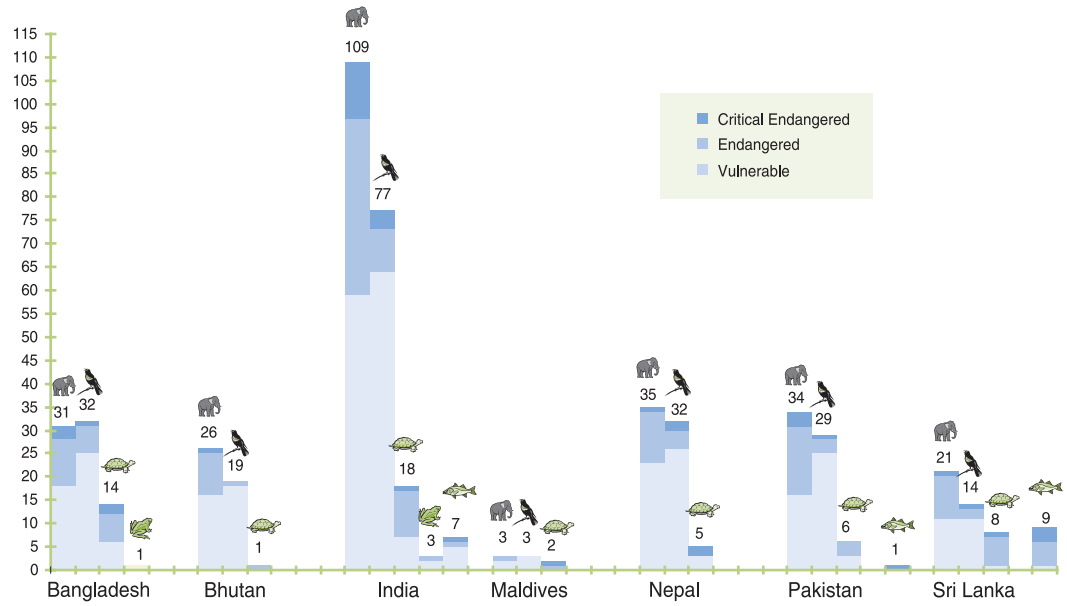
In South Asia, coral reefs are mainly found in the Arabian Sea and the Indian Ocean along the Gulf of Kutch (Gujarat) in India, western India, the Lakshdweep islands, the Andaman and Nicobar isalnds, the Gulf of Mannar in India and Sri Lanka, and throughout the chain of islands in the Maldives. The distribution of coral reefs in the region is as follows: India (18,000 sq. km.), Maldives (7,64,000 sq. km. approx), Sri Lanka (31,700 sq. km.) and Bangladesh (12,800 sq. km.).

Since the past two years, South Asian reefs have suffered extensive damage due to the increase in ocean temperatures, which is thought to be related to the El Nino phenomenon. The increasing temperatures result in severe coral bleaching. Corals being extremely sensitive to even small changes in temperature, even an increase of one degree above the normal results in them loosing their vibrant colours (due to death of the algae which inhabit them and give the corals their brilliant colours).

Coral reefs in the Maldives were reported to have suffered heavy damage during the 1998 ocean warming phenomenon, although some signs of partial recovery have been reported. Maldives reported almost 95 per cent mortality of mostly Acropora communities, soft corals and anemones from North Male and Ari Atoll. Many massive corals are still under stress and partially bleached.

Similar bleaching was reported at Kavaratti and Lakshadweep islands in India. In May 1998, the Andaman sea was reported to be two degrees warmer than usual. A study of five sites along a 40-km stretch around the islands conducted by SANE (Society for Andaman and Nicobar Ecology) indicates that there was 100 per cent bleaching in the Andaman reefs and 30-70 per cent in Nicobar. Scientists of the National Institute of Oceanography, Goa in India found major damage to coral reefs of the Kavaratti and Kadamat islands in Lakshadweep.

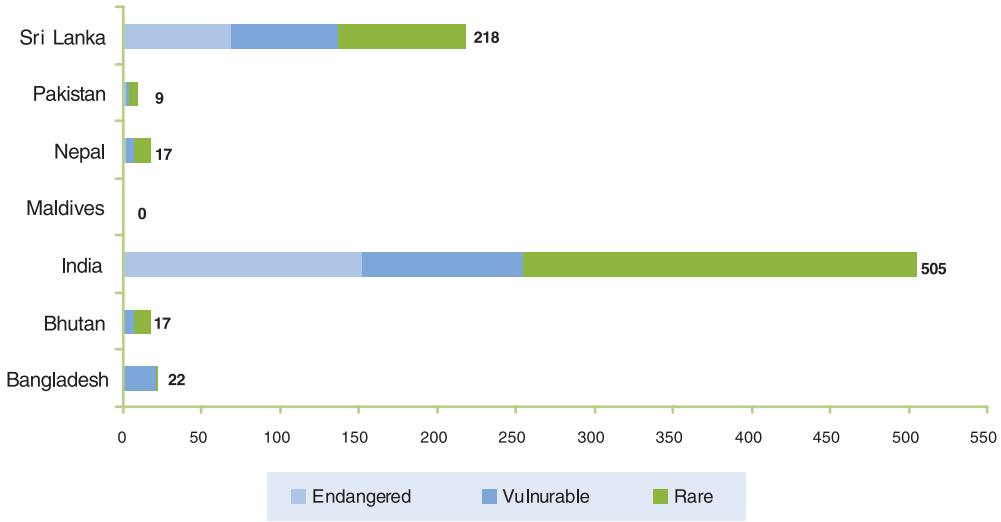
Threatened Fauna of South Asia



	Bangladesh					Bhutan					India					Maldives					Nepal					Pakistan					Sri Lanka				
VUL	18	25	6	1	0	16	18	0	0	0	59	64	7	2	5	2	3	0	0	0	23	26	3	0	0	16	25	3	0	0	11	11	1	0	1
EN	10	6	6	0	0	9	1	1	0	0	38	9	10	1	1	1	0	1	0	0	11	4	0	0	0	15	3	3	0	0	9	2	6	0	5
CR	3	1	2	0	0	1	0	0	0	0	12	4	1	0	1	0	0	1	0	0	1	2	2	0	0	3	1	0	0	1	1	1	1	0	3

Source: WCMC Database, 1998 Web: www.unep-wcmc.org

Threatened Flora of South Asia



Species	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Endangered	0	1	152	0	2	2	69
Vulnurable	21	6	102	0	5	2	68
Rare	1	10	251	0	10	5	81

Source: IUCN Red Data Book of Plants 1997

region, particularly India, Nepal, Bhutan and Sri Lanka, have had strong cultural and religious traditions which stress on the importance of environment and conservation. For example, the setting aside of land by local communities as 'sacred groves' (due to religious significance of the flora present in the area) is one of the oldest known conservation practices in the region.

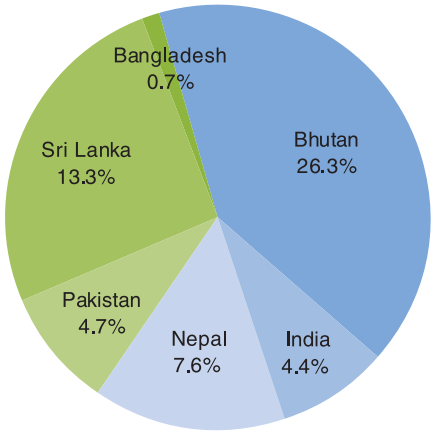
The importance of the conservation of wild plant resources is officially recognised by most countries within the region. Bhutan is not a party to any international convention concerned with protecting natural areas; neither does it participate in the UNESCO Man and Biosphere Programme. But at the national level, Bhutan has maintained a strict conservation policy and places great emphasis on maintaining at least 60 per cent of its land area under closed forests in order to sustain climatic equilibrium and to prevent soil erosion. Within the region, Bhutan has the distinction of being the only country with 70 per cent forest cover and nearly 22 per cent of its land under protection.

Across South Asia's other nations, there exists an extensive system of protected areas which offer shelter to diverse ecosystems and habitats of endangered and endemic species of wildlife. However, because of the ever increasing demand for space to accommodate the burgeoning populations, not all ecosystems have and can be brought under protection. At the same time, those areas which have been accorded some form of protection are not totally protected, as they are plagued by problems of weak legislation, untrained and limited personnel, and inadequate motivation and training. Besides insufficient funding, inappropriate equipment and lack of practical and effective management plans often render these protective measures ineffective.

At the national level, most countries have come up with National Biodiversity Action Plans which outline the threats to the biodiversity and the proposed planning for promoting conservation. Bangladesh has commenced preparation of such an action plan which is expected to assist in assessing its biodiversity and formulating a plan for sustainable development using the resources it provides. Maldives too is currently working on preparing and implementing a national biodiversity strategy and action plan. This entails identifying sites of high biodiversity significant for conservation, tourism and other sustainable development opportunities.

Nepal is in the process of preparing a National Biodiversity Action Plan under the GEF-funded Biodiversity Conservation Project. The plan is expected to provide a comprehensive strategy for coordinated efforts by all the stakeholders related to forestry, wildlife, agriculture and tourism sectors, as wel as communities. It will also facilitate identification of gaps in biodiversity conservation initiatives and assessment of emerging trends of Nepal's biodiversity.

Protected areas coverin South Asia
as percentage of total land cover



The National Environment Action Plan of the Maldives outlines actions, policies and measures to protect and conserve the fragile biological diversity, particularly the marine ecosystem and integrated sustainable reef resources management. India has developed a National Policy and a Macro-level Action Strategy on Biodiversity, which is aimed at providing the framework for preparing detailed action programmes at the macro level for conservation and sustainable use of the biological diversity that exists in the country.

Sri Lanka's Biodiversity Conservation Plan (BCAP) forms a broad framework for action for biodiversity conservation at the national level. It was prepared through wide stakeholder participation by the government and NGOs. A biodiversity secretariat has been set up by the Ministry of Forestry and Environment for implementation of BCAP, and initiatives include development measures for valuation of biodiversity, conservation of medicinal plants, establishment of a legal task force to identify gaps and recommendations in national legislation.

An increasing trend of decentralisation and devolution of forest management responsibilities to local government, user groups and local communities is evident from the Joint Forest Management Programmes in India and from the transfer of forest lands to local user groups in Nepal. Bangladesh, Bhutan and Pakistan have completed the National Forestry Action Programme Framework (NFAP) planning phase and are in various stages of programme

Table 40: Adherence to International Conventions in South Asia

Country	CITES	World Heritage Convention			Ramsar (Wetlands) Convention			Convention on Biological Diversity
		Date ratification	No. of sites	Area (ha)	Date ratification	No. of sites	Area (ha)	Date of
Bangladesh	Ratified (20/11/81)	1983	1	1,39,700	1992	1	59,600	1995
Bhutan	-	-	-	-	-	-	-	-
India	Ratified (20/7/76)	1977	5	2,81,012	1981	6	1,92,973	1994
Maldives	-	-	-	-	-	-	-	-
Nepal	Accession (18/06/75)	1978	2	2,08,000	1987	1	17,500	1994
Pakistan	Accession (20/04/76)	1976	-	-	1976	12	62,908	1994
Sri Lanka	Accession (04/05/79)	1980	1	8,864	1990	1	6,216	1994

Source : IUCN (1998) & WCPAM Membership

execution, while planning activities are underway in India. Nepal and Sri Lanka, who developed their action plans long ago, are presently reviewing and revising their NFAPs.

Some countries in the region, particularly India and Nepal, have initiated conservation projects targeting specific species which are endangered and need imminent attention.

At the regional level, the United Nations Environment Programme (UNEP) in collaboration with the South Asia Cooperpative Environment Programme (SACEP) and governments in the region, has initiated the South Asian Seas Regional Programme, to promote the protection of the marine environment and sound management of the South Asian seas. Following the 1998 El Nino-related rise in sea surface temperatures in the region and the resulting extensive damage to coral reefs, there seems to be an increased awareness and need felt in the national government sectors and resource-user groups that better management is required for future sustainability of coral reef resources in South Asia. Trainings conducted by the Global Coral Reef Monitoring Network and SACEP have enhanced monitoring capabilities. While India, Sri Lanka and Maldvies have initiated new programmes at the national Level, in Pakistan and Bangladesh the new programmes wil be conducted under the integrated coastal zone management planned in the near future (*Rajasuriya, Arjan, 1998*). At the international level too, most countries of South Asia are party to different treaties/conventions aimed at promoting and protecting biological resources.

Besides efforts by the governments, a large number of initiatives towards conservation of biodiversity have been undertaken by non-governmental organisations (both national and international), community-based organisations, individuals and institutions, particularly in the past few decades. Most of these efforts have been towards awareness generation, involving local communities in planning and implementation of conservation projects, environmental education by involvement of children and the documentation of traditional conservation practices.

Inspite of the responses at different levels, the destruction of biodiversity continues unabated in the region. The loss of the region's biological resources would result inevitably in serious consequences for not only the people within the region, but also for those in other far-flung corners of the world who benefit from the region's biological richness. While the South Asian biodiversity may hold cures for some widespread fatal diseases such as AIDS and cancer, the region as a whole needs to set up systems for using this wealth as a bargaining chip with the rest of the world.

However, with development processes that are accelerating, Bhutan today stands at the crossroads. The kingdom is faced with many difficult issues related to environment, development and population growth and associated demographic changes. The country's future depends on a range of decisions and strategies to be implemented in the coming years, because the right decisions can lead to greater prosperity, greater

Isolation: a Solution to Greenery?
Green amidst brown

While many South Asian countries have seen their natural resource base degraded by rampant deforestation, soil erosion and the consequences of over population and pollution, there is one bright spot tucked away in the corner of the Himalayas – the mountain kingdom of Bhutan, which is one of the last remaining green patches in the mountains.

The country remained isolated, by deliberate policy, for centuries, and only began to open up to the rest of the world in the late 1960s. When it was realised what was happening to its neighbours, the government became determined not to develop in the same way, and adopted a strict conservationist policy. In 1974, it stipulated that 60 per cent of the country should remain under forest cover in perpetuity; this was no small target as about 35 per cent of its land is above the tree line. In 1979, it stopped private contractors from cutting timber; national production fell by 87 per cent in two years. Felling by shifting cultivators was also banned, though less successfully. Another law cut the population of goats - one of the great destroyers of the land - by four-fifths and restricted them to stalls where they do no damage. Lastly, the government has started giving every village a patch of forest to manage as its own responsibility

(WWF, 1994).

diversification of the economy and greater security against natural and man-made threats. Though adopting an appropriate path for development that sustains the country's natural resource base will not be easy, the Royal Government of Bhutan is committed towards following its strong tradition of environmental conservation and preservation. The 73rd session of the National Assembly in 1995 mandated that the country must at all times keep 60 per cent of its area under forest cover. Five years since, the pro-environment approach is explicit in the kind of developmental policies that the government has undertaken towards sustainable forest management.

Emerging Priorities/Challenges for the Future

The different countries within South Asia have a wide diversity in terms of culture, history, religion and economy, but as an regional entity, there is a lot of commonality which makes the region a whole unit. It is being felt increasingly that within the region, there is a lot that one country can learn from the others and the region as a whole if united, and can jointly strive towards self-reliance and sustainable development. However, before the mechanisms for the same are set in place, there is a need for greater cooperation and regional networking. The emerging priorities for protection and sustainable use of the South Asian biodiversity include:

Assessing and documenting the biodiversity wealth of the region:

- Integration of efforts being made at the national level in the countries within the region to assess and document the biological wealth of South Asia as a region.

Promoting regional cooperation and planning:

- Regularising collaboration of scientific and other personnel working in the areas of integrated biodiversity conservation for formulating regional action plans.
- Establishing a mechanism for bringing together people (government officials, community representatives, NGOs and academicians) from the different countries of the region to share their experiences and approaches to biodiversity conservation on a regular basis. This would provide an ideal forum for the exchange of stories of success and failure and an opportunity to learn from failures and replicating and building on successes.
- Promoting regional planning practices to integrate protected areas planning and management with surrounding land use. Variation in the categories of protected areas and regional planning will enable formulation of comprehensive conservation strategies to manage protected areas more effectively, including the management of fragmented habitats and corridors linking protected areas.
- Identification of trans-boundary issues related to protected areas requiring cooperative management.
- Developing the capacity of research institutions within the region to meet the requirement of research support for biodiversity conservation.
- Seek enhancement of budgetary allocations from governments by raising awareness levels among planners, decision-makers and politicians.
- Share fund-raising experiences among countries of the region to take advantage of available funds from bilateral and multilateral sources.

Biodiversity as a bargaining chip in international market to curtail bio-piracy:

- Lack of adequate knowledge and assessment, and poor documentation of the precious biological wealth, increasing unemployment and poor awareness among the common masses, and inadequate regulation have resulted in multinational companies operating within and outside the region as well as individuals in pursuit of their commercial motives, plundering the biodiversity wealth.
- Instead of using the potential of this substantial wealth as a bargaining chip, the countries in the region end up incurring enormous expenditures in importing essential and important drugs, medicines and other products - the raw materials for most of which were surreptitiously taken from the region itself.
- Bio-prospecting as a tool to mitigate bio-piracy can be effectively employed.

The regional regulating authority and the legislation could look into the following issues:

- *Royalty from joint ventures and domestic companies:* Establish a mechanism for demanding a one time royalty from joint ventures and domestic companies with provision for annulment of the agreement in case of violation of law. This must also ensure that the local communities who have been the guardians of our natural wealth for centuries and from generations, receive equitable share of the benefits.
- *Integrating the importance of conservation in all sectors:* Political will and government support for incorporating and integrating conservation and sustainable use of biological resources into all the economic and development sectors.
- *Strengthening the information base on biodiversity:* Inventorisation and documentation of local communitys' traditional knowledge of biological resources, particularly of plants (ethnobotany), and their involvement in any measure that is taken to curb bio-piracy.

Effective demarcation incorporating habitat zones:

- Countries within the region should strive to bring more areas under protection within the region.
- National systems plan for protection of terrestrial and marine biodiversity.
- The gap analysed in the National Plan can be addressed in the planning for a regional systems plan incorporating trans-boundary issues and concerns recommending demarcation of protected areas on a bio-geographic basis for the region as a whole.
- Management of marine areas and wetlands needs to be integrated with land use in the surrounding areas in coordination with other agencies and involved parties, such as fisherfolk, coastal communities, etc.
- Setting up of a networking monitoring system to prevent poaching and illegal trade in wildlife.
- Documenting the region's biodiversity, particularly of those species whose population is dwindling and is subject to maximum threat due to illegal trade, and according uniform regional status (threatened, vulnerable, critical, etc.) based on the international criteria set up by the IUCN and other organisations.
- Based on the documentation and information base, mechanisms must be urgently set up through cooperation of enforcement agencies within the different countries of the region for preventing illegal trafficking in wildlife.
- Setting up of a regional network to periodically monitor implementation and also to review the situation in the region.

Revival of traditional knowledge and promoting environment-friendly practices:

- Several countries in the region - particularly India, Sri Lanka and Bhutan - have a history of traditional conservation practices and it is imperative that this knowledge and practice be documented before they are lost.
- Large scale efforts with the involvement of community-based organisations and NGOs should be made for creating awareness on the importance of these traditional practices as well as their revival and propagation.

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PART III

Challenges and Recommendations

Having discussed the environmental problems faced by the region, it is essential to also focus on recommendations for possible solutions.

The issues this section addresses include building large-scale awareness and capacity, operationalising participatory governance and decision-making, promoting regional and global co-operation, strengthening technological capacity and securing the economic base.

1.0 Building Large-Scale Awareness and Local Capacity

One of the most effective ways of tackling the environmental problems of South Asia (or of any region, for that mater) is through spreading awareness and empowering the people, which would enable them to take decisions on their own. Based on these decisions, they would initiate actions beneficial to themselves as well as to the local environment.

Experience tells us that solutions emerge wherever people are aware and involved in solving their problems, wherever there is a sense of participation, wherever people and their governments work together. The countries in South Asia are recognizing the immensity of the challenges of sustainable development they are facing, and the vital role that environmental education can play in helping them meet these challenges (*News Environment Education, Vol. 3, No. 5, Sept-Oct 1997*).

Of course, the region is not a stranger to environmental education. Centuries of careful tending of the land on which communities have depended, is just an example of the region's talent for harmonious co-existence with nature. Each generation has passed on its profound understanding of how to manage natural resources to those who follow. In many nations of the region, religious philosophy too has a bearing on traditional relationship with the environment. In Bhutan, for instance, Buddhist philosophy advocates environmental protection and prevention of environmental disturbance. Similarly, followers of Hinduism worship trees and animals, and Jainism believes the killing of any creature, big or small, to be a sin.

1.1 Major Areas where Awareness and Local Capacity Building are Required

- The major challenge facing this region is that of rapid population growth. Education and awareness, better health facilities, accessibility to birth control methods and promoting a woman's right to exercise her decisions are the solutions to this.
- The quickening pace of development, industrialization, urbanization and population growth is challenging traditional practices. Traditional sciences such as the use of medicinal plants, organic farming, and traditional arts and crafts such as the use of vegetable dyes for dyeing clothes, are fast losing out to the glamour of the so-called West-influenced development.
- Farmers need to be educated about better and more sustainable agricultural practices.
- Wasteful use of resources, a practice common to the affluent sections of our society, remains one of the principal causes of environmental problems in the region. The per capita consumption of water, energy and food in urban centres are many times more than those of their rural counterparts. Unlike developed nations where recycling industries are firmly in place and thus high consumption pressures can be withstood, this region, especially its urban centres, is not yet used to the concept and practice of recycling. The value of conserving resources (water, energy) and products (food) needs to be imbibed in each individual, especially in the affluent sections.
- Conserving the rich biodiversity and using it sustainably for the economic benefit of the region is another major challenge. The local people need to be educated about the natural wealth they possess, so that the developed world does not take undue advantage of their centuries-old traditions and knowledge - by patenting it, for instance. Governments, in cooperation with local communities, can document this knowledge for posterity and as a step towards protection against unfair patents.

1.2 Levels of Environmental Education

The dissemination of awareness and education about the environment has been discussed under two broad heads - through formal education and through informal means.

Formal Education

The formal education system provides a good framework for reaching out to a large segment of the population and can help make future generations conscious of the importance of environmental conservation.

Most countries in the region have made efforts to introduce environmental education into their primary, secondary and tertiary syllabi with varying degrees of success. The approaches used at the pedagogical level have included making environmental studies a separate course or incorporating environmental education into existing curricula at the primary and secondary levels. Many schools have organized and established eco-clubs, the members of which take part in different environmental awareness-and-action activities. There is a definite increase in awareness among school-going children about the threats to the environment and many of them, in their own small ways, are contributing through activities to preserve the environment (such as discarding polybags, planting trees, etc).

At many places, formal education is supplemented through activities carried out using a wide range of channels that may include visits to field study centres, museums and parks, use of audio-visual material, bringing out children's magazines, etc. NGOs and universities in some countries play a major role in training teachers and providing the material for formal education.

Action programmes and campaigns:
Environmental conservation is a task of such magnitude that no government or group, however influential or knowledgeable, can undertake it successfully without the cooperation of the people. Efforts, therefore, have been made through campaigns to arouse - in the people - a concern for and awareness of the environment.

Recommendations for making environmental awareness more effective at a formal level:

- Improve the quality of school curricula to make learning and teaching about environment more effective.
- Review, select and make available adequate supplementary educational materials that have already been developed, for use in primary and secondary schools.
- Produce educational material on environmental issues (that have not been adequately covered) in the form of case studies, and on emerging conditions relating to environment.
- Organise training courses for teachers and introduce field-oriented methods of teaching about the environment.
- Initiate schemes to motivate teachers and schools to enhance the level of environmental education.
- Encourage and support NGOs to undertake environmental awareness programmes.

Informal Education

Religious institutions:
Naming a piece of land after a god (as in the case of sacred groves), or giving away tree saplings as blessings, are long established practices in the region, which are still being used to preserve our environment.

Industrial sectors:
While large industries and corporates are generally aware of their responsibility towards the environment (more so because the law keeps a close watch on them), the smaller factories and workshops are the ones that actively flout environmental regulations, both knowingly and unknowingly. Awareness generation and providing them with cleaner and greener alternatives and technologies should be a major concern for all the countries in the region. In this context, the sharing of information and technologies by research institutions, regionally and globally, is crucial.

Women:
Women have a special affinity for helping the cause of sustainable development; they play a critical role in determining some factors that affect sustainable development. For example, women are important for success in energy conservation measures - they are the cooks and (by virtue of their role as gatherers of fuel) the providers of energy. Moreover, women can play a crucial role in the planting of trees as an alternative to covering long distances to collect firewood. In India, local forests established by women have a much higher chance of survival than those planted by the government: the ratio stands at 80 per cent for the women compared to 20-30 per cent for the government. The role of women in household sanitation and health is no less significant. More than any hydrologist or urban planner, it is the women in the developing world - the drawers, carriers and household managers of water - who understand what water scarcity is and its implications for communities.

Despite this, access to informal environmental education for women is low in this region. Most environmental training programmes on soil regeneration, afforestation, energy saving and water management do not provide learning opportunities for women. What is needed, therefore, is better opportunities for women to translate their knowledge and initiatives into concrete action and control - over natural resources such as water, as well as over their own lives. By offering them opportunities in education, economic and political life and in decision-making, governments in the region could vastly improve on their management.

1.3 Communication and Environmental Awareness

The essence of environmental communication is to convince people that there is a problem at hand that requires urgent attention. With a host of messages competing every moment for the public's attention, the task of delivering any particular one is by no means easy. Numerous channels of communication - ranging from print and electronic media to folk art and community communicators such as NGOs and action groups - have been used to promote environmental awareness among the people. These have achieved substantial success in raising environmental consciousness over the years.

Until a few years ago, environment reportage was largely limited to covering speeches or tree-planting campaigns on Environment Day. Today, journalists work closely with environmental activists, and are much more proactive and focussed on the larger issues. Media coverage of environmental issues has not only increased in recent years but has also become more diverse. Besides local issues, global ones such as the greenhouse effect, ozone depletion and loss of biodiversity are increasingly coming in the limelight.

The role and the reach of various media in dissemination of environmental information vary. The print media, radio and television dominate the urban areas, whereas traditional and interpersonal forms of communication appear to be far more effective in rural areas. Radio is a powerful medium reaching most parts of the country by using local languages to transmit its information. The *Pakistan NCS Document* points out: "Radio is particularly instrumental in reaching the two largest and pivotal audience groups. First, it can influence subsistence users of natural resources, and second, it can reach a majority of women - the repositories of values, the managers of water, forest and fuel, and the processors of subsistence agriculture - who have to bear the burdens of dwindling resources." (*p. 254*).

Communications through the folk media is also an effective age-old technique. Experiments have demonstrated that people residing in rural areas respond most readily when communicators relate to their own local circumstances and cultures, and when they interact with the audience. A UNESCO study in Sri Lanka showed that story-tellers were by far the most effective communicators, followed by balladeers, monkey performers, acrobats and tom-tom beaters; television and posters were far less influential (*UNEP, 1988*). As for the electronic media, it has generally proved persuasive when it has adopted the traditional methods of dissemination: humour, discussion, illustration through dramatisation, and song-and-dance sequences - as applied successfully in Nepal, Sri Lanka and Ahmedabad, India (*UNEP, 1985*).

Recommendations for Making Environmental Awareness more Effective

- Education and communication has, as a general rule, been always starved of funds. Financial allocations by governments for education are miniscule in comparison to investments made in, for instance, infrastructure development. Enhanced awareness and greater public understanding of environmental and development issues is vital for the success of all other development programmes. In other words, a strong educational and communication sector is akin to an insurance policy to secure the future (*State of the Environment in Asia and Pacific, 1995*). Increased financial allocation is, therefore, a primary requirement.
- Initiate regional and global cooperation in sharing educational material, such as case studies.
- Encourage support to NGOs for carrying out environmental awareness programmes.
- Formulate a comprehensive country-wide awareness programme through the print and audio-visual media, and seek private support for the programme.
- There is a tendency to focus on formal school education target groups by both governments and NGOs, rather than addressing groups that can make a difference in a policy issue. In reality, our environment is managed by a wide variety of individuals in society. It includes managers of resources (such as town planners and forest officials), teachers (who disseminate environmental information and thus influence the management), and rural women, farmers and urban housewives (who exercise a direct impact on our environment). Governments and NGOs should make these groups the prime targets for their awareness generation campaigns.

2.0 Operationalising Participatory Governance and Decision Making

Developing nations have very few legislations in place for protection of the environment. As most of these nations have large populations living below the poverty line, the stress is on meeting the basic requirements of food, clothing and housing. Even where there are laws and policies on the subject, their implementation leaves a lot to be desired.

2.1 Effective Implementation of Laws and Policies

The region has no effective mechanisms for conserving biodiversity, for checking illegal logging or fishing and trade in species, or for ensuring the conservation of forest and water resources. Large-scale migrations in the urban sector have resulted in pollution, deforestation, water contamination and extremely unhygienic living conditions. Development work continues to be haphazard and without any coordination, leading to financial losses and wasted efforts. Governments impose on the people what they think is best without ascertaining the people's needs. Regional conflicts and insurgent situations have become barriers to sustainable development and the creation of livelihoods for the weaker sections of the society.

On the other hand, as awareness about environmental issues increases, societies are getting together for exchanging views and discussing strategic plans and practical experiences. Awareness by itself, however, cannot be an answer to a problem of such a magnitude. What is of essence is implementation. There have been cases where the judiciary has passed judgements, but the rulings remain idle in the absence of implementation. This is more so in urban societies beset by the problems of urban waste disposal, sewage treatment, land encroachment and degradation. Stringent environmental laws do not necessarily mean effective implementation. Civic authorities have to ensure that judicial orders, when passed, are obeyed.

2.2 Regional Cooperation

South Asian countries continue to face problems of regional cooperation. It is surprising that nations which had a common past under colonial rule, cannot now solve their problems through mutual consultation. The region is plagued by problems of disputes on territory, utilization of water, abetment to terrorism, illegal trade, natural calamities, refugees and migrations, ethnic conflicts, etc. At present, there is no mechanism to arbitrate these disputes. Mutual suspicion between the governments of the region seems to be the rule rather than the exception. The larger nations are seen as hegemonistic while the smaller are believed to be trying to extract undue advantage.

Adjudicating mechanisms - such as tribunals - are the need of the hour. The countries of the region have to get together to combat disasters and the other problems that they are faced with. At a higher level, they can cooperate and jointly bargain with other regions and the developed world on issues such as carbon emission trading, exports and imports, information technology, etc. Unless a framework for co-operation is formulated and the countries give assurances to abide by it, no worthwhile co-operation would be possible. Disputes should be settled politically and not militarily or by coercion; trans-boundary migration problems should be checked, with the country of origin taking back the illegal migrants if detected; countries should accord most favoured treatment in trade to each other. Collective resolution of environmental issues also becomes easier in such a case.

2.3 Interactive Approach

Most South Asian countries suffer from a lack of interaction between the government and the society. The civic structures, such as the municipal bodies and undertakings, carry out their tasks according to the guidelines that have been issued them. Suggestions, incorporations or improvements are regarded with suspicion, and as being violative of their charter of duties. Even among the various public service utilities, clear demarcation of activities remains a grey area. More often than not, the tendency is to wash one's hands off with the excuse that it is the other's job. It is very important for the services to be in close synergy with communities, particularly in the urban context. On their part, the communities should constantly interact with the service providers for a constructive approach to the improvement of the environment.

It has to be clearly understood that a government cannot sustain and improve environmental quality without the active cooperation of the people. A sense of commitment and dedication from all stakeholders is essential for creating the systems that can monitor and take timely action for preventing the degradation of the region's environment.

3.0 Promoting Regional and Global Co-operation

Asia is assuming importance in terms of its centrality to global geopolitics and geoeconomics. Though characterised by tensions and conflicts, the continent is also an area of potential economic growth. South Asia is home to a phenomenal quantity of skilled manpower. It also houses some of the largest emerging markets in the world. Similarly, the South-east Asian region, which can also be termed as a growth triangle, has large reserves of economic and technological resources. Such a diverse resource base can be pooled together for a broader regional co-operation in Asia, which will in turn engender durable peace and security in the region.

3.1 Regional Co-operation on Environmental Issues

The South Asian countries have taken several major initiatives to address environmental issues through regional co-operation. The first of these was taken in the third summit of the SAARC in 1987 at Kathmandu, Nepal. The summit decided to commission a study on 'Causes and Consequences of Natural Disasters and the Protection and Preservation of the Environment'. The second such initiative on environment was taken by the fourth SAARC summit, held at Islamabad in 1988. The summit proposed to undertake a joint study on the greenhouse effect and its impact on the region.

3.2 Co-operation in Trade and Investment

The leading economic organisation in the region, the Asia-Pacific Economic Cooperation Forum (APEC), links 18 countries around the Pacific rim, spanning from East Asia and Australia to North America, Mexico and Chile. Within APEC, some 70 per cent of trade and 65 per cent of investment is intra-regional. APEC economies have embraced a vision of "free and open trade and investment" by 2010 for the developed and by 2020 for the developing nations.

Opening up of regional trade will help expand production and employment in all the countries, bring down costs of living, and help reap the benefits of large technology-led mass markets. Across-the-board reductions in tariff and non-tariff barriers within five years, therefore, is the need of the hour - i.e., the region needs a SAFTA (a South Asian Free Trade Association), rather than the existing SAPTA (the South Asian Preferential Trade Agreement). An appropriate strategy of decentralised labour intensive industrialisation could then follow.

South Asian Regional Seas Programme

The South Asian Regional Seas Programme is one of 13 such programmes initiated by the United Nations Environment Programme (UNEP). The major objective of this programme is to ensure protection and rational management of the marine environment. Except the two land-locked countries of Bhutan and Nepal, all the SAARC countries have participated in this programme, which was formulated in 1983. The programme is usually operated through the effective implementation of an Action Plan.

The first draft Acton Plan was formulated by UNEP in 1985. Due to a lack of consensus on certain issues such as the need for a regional legal framework for the Action Plan and the funding mechanism, the Action Plan was not finalised till 1994. After the 1992 Earth Summit, it became imperative to implement - through regional co-operation - several aspects under Chapter 17 of Agenda 21, which deals with marine environment. To facilitate such co-operation, the UNEP finally gave its assent to the Action Plan. The Plan was adopted on March 24, 1995, in a meeting of the plenipotentiaries of the region, held in New Delhi. India is the repository of the Final Act which conveys the adoption of the Action Plan by the countries concerned.

The objective of the Action Plan is to protect and manage the marine environment and related coastal ecosystems of the region. This includes promotion of sustainable development and sound management of regional marine and coastal resources by

(i) establishing and enhancing consultancy and technical cooperation among the states of the region;
(ii) emphasizing the economic and social importance of the resources of marine and coastal environments; and
(iii) establishing a regional cooperative network of activities concerning concrete subjects/projects of mutual interest for the whole region.

The South Asia Co-operative Environment Programme (SACEP), Colombo, Sri Lanka has been designated as the secretariat of the programme.

Source: Ministry of Environment and Forests, Government of India (1977)

3.3 Co-operation in Setting Regional Standards and Monitoring

Environmental standards in developing countries are generally poorer than those maintained in the developed world. The absence of adequate technology that can generate environmentally friendly substitutes is a major constraint. The region suffers from a profusion of 'dirty' industries - chemicals, leather, paper, cement, etc - that pollute land, air and water, causing severe damages to terrestrial and marine ecosystems. These damages are in addition to their direct adverse effects on human health and livelihood patterns. Although some industries these days are able to aquire eco-labels and ISO 14000 certifications, most are generally dominated by small- and medium-scale enterprises (SMEs), which are unable to afford the cost of implementing environmental management systems. Regional cooperation among SMEs is required to address this problem.

3.4 Co-operation in Energy-related Pollution Monitoring

Energy-related environmental pollution, especially acid deposition, also crosses national boundaries in Asia. Regional co-operation can help monitor emissions. Moreover, regional initiatives can reduce the costs of mitigating the effects of acid rain by pooling scientific and management resources and by helping to build management capacities.

3.5 Co-operation in Regional Water Quality Management

The region needs to develop a water quality monitoring strategy. Neighbouring countries which share a single water source, should coordinate activities such as environmental pollution control and the development of water resources. Focus should be on standardizing environmental legislation in the region with reference to environmental standards, training programmes on Environmental Impact Assessment (EIA) procedures, water quality management and industrial pollution control, as well as appropriate technology transfers within the region. Furthermore, the role of community and NGO participation in water management should be encouraged.

Water resource data collection and sharing:
Regional data collection and sharing is an important part of the national management of the resource. The countries in the region must have a basic water resource data that can be used for satisfactory agreements on allocation and for responses during shortages or floods.

***Transboundary water sharing*:**
Development of large river basins requires consensus building and arriving at agreements through negotiations for sharing the resources within a country or among the countries of the region. India has a good network of rivers, and some of these either originate from or flow through neighbouring countries, necessitating water-sharing agreements. Similarly, Bangladesh has 57 rivers which originate from neighbouring countries such as India and Myanmar (53 from India and 3 from Myanmar). The Joint River Commission of India and Bangladesh is responsible for resolving all issues related to the sharing of waters of common rivers. But, as of now, only the 1996 agreement for sharing the waters of the river Ganga at Farakka is in force. In fact, the development of the Ganga basin requires multilateral co-operation among India, Nepal and Bangladesh.

The Indus Water Treaty between India and Pakistan for sharing the waters of the Indus system provides for a permanent Indus Commission with Commissioners appointed by both the countries. India and Nepal have already jointly undertaken the construction of the Pancheswar dam on the Indus, which is their common border.

3.6 Co-operation in Regional Food Security

Poverty eradication and the right to food go hand in hand. The strategy for South Asia in this sector should be to greatly increase sustainable food production and do more to support farmers with better research, information, infrastructure and incentives, within a broadly favourable and stable macro-economic environment.

At the international level, trade barriers and policies have brought down the prices of many crops which are critical to the economies and the farmers of developing nations. Radical reforms and a uniform policy on food pricing and trading are required to enable significant increases in production.

The UN has been encouraging the approach of Technical Co-operation among Developing Countries (TCDC). Food security and control can benefit from this approach, particularly in the areas of manpower development and capacity building.

Agreement on Establishing the SAARC Food Security Reserve (SFSR)

An agreement on establishing the SAARC Food Security Reserve was signed during the third SAARC Summit (Kathmandu, 1987). The agreement, which came into force on August 12, 1988, provided for a reserve of foodgrains for meeting emergencies in member countries. The size of the reserve stands at 241,580 tonnes at present.

The SAARC Food Security Board comprises representatives from each member country and meets once a year. The main functions of the Board are to undertake a periodic review and assessment of the food situation and prospects in the region, including factors such as production, consumption, trade, prices, quality and stocks of foodgrains.

The SFSR agreement requires adequate action research and planning for it to play a significant role in international trade with a view to protecting the social and economic rights of poor/marginal farmers.

3.7 Common Policy on Hazardous Waste Imports

Trans-boundary movement of hazardous wastes is emerging as a critical issue, which countries in this region have not been able to address fully. Although seven out of nine countries in South Asia have signed the Basel Convention, the region lacks a common approach to the issue of import of hazardous wastes.

In Bhutan, where cheap power is available, recycling of waste is emerging as an important economic activity. The same is true with the other countries, the most dramatic being the ship-breaking industry in the coastal regions of India and Pakistan. The impact of these trends in the context of trans-boundary issues is as yet uncertain, but it is clear that the institutional and regulatory capacity of the countries in this region for surveillance of the import of hazardous wastes is limited and not addressed co-operatively.

3.8 Co-operation in Energy and Market Governance

The recommended strategy for the region should be to promote regional co-operation in nudging markets towards an energy path, which can enhance both environmental and supply security. Small-scale renewable energy technologies can offer proven and environmentally benign alternatives to grid-based power. In India, less than 40 per cent of households are connected to the grid. Nonetheless, like a shift to natural gas, a major shift towards renewable energy sources is still some way off in the future. A regional institutional framework must create explicit windows for directing scientific inputs into policy debate and design. Environmental groups are often a source of innovative policy ideas and also act as transmission vehicles for information and communication flows between governments and communities. Moreover, a vibrant regional network outside the official lines of government can help build popular support for a regional energy strategy.

Regional Governance of Energy Markets

In Asia, a framework for energy governance is probably the single most important component of a path towards sustainable development. Global markets, like global ecosystems, require global governance. The Framework Convention on Climate Change, if successful, will set broad parameters for controlling greenhouse gases, which will affect energy markets worldwide. Regional approaches either towards creation or implementation of a governance framework could be an easier option.

For capital markets, two approaches might be fruitful. First, governments could collectively set environmental guidelines for energy infrastructure and power sector development. Such guidelines could be implemented through regional social and environmental impact assessment and mitigation strategies. They could also require public hearings or other avenues of public input into the design and construction of resource development projects and power plants.

Second, governments in Asia can promote their own environmental guidelines for investment. The primary goal of such instruments would be to find ways to capture the social and cross-border benefits of investment in cleaner technologies when markets (or governments) are reluctant to finance them.

There is substantial room for improving energy efficiency in the region. India uses 60 per cent more energy per dollar of GDP than the world average. China uses 20 times as much primary energy to produce a dollar's worth of economic products as does Japan. Only part of the difference stems from the different structure of the two economies; the rest stems from inefficient equipment and outmoded practices. The embrace of best available coal burning technologies and cleaner fuels will require innovative financing instruments. The key is in mobilising capital markets to deliver in this area.

Regulations and standards:
As reflections of different histories and socio-economic conditions, energy regulations and standards vary widely in Asia. Market integration, however, creates pressures for standards to converge. South-east Asian nations, for example, have moved to integrate EIA requirements and ambient environmental standards as part of the process of establishing the ASEAN Free Trade Area (AFTA).

The crucial policy issues are two-fold: first, how to push convergence upward towards a higher (rather than lower) level of environmental performance, and second, how to manage an upward-convergence process in a way which recognizes the region's diverse needs and concerns. Rather than harmonization of specific standards, diversity might entail the adoption of broad regional principles, guidelines and methodologies.

One category in which (upward) convergence would offer significant environmental benefits is energy efficiency standards. With common standards, markets for key energy-users in case of goods such as air conditioners and refrigerators would help disseminate the more efficient products. Higher standards would also stimulate innovation in higher-efficiency products and applications.

There are likely to be significant impacts, however, on competitiveness, with imports replacing locally-produced products. As a result, there will be opposition by some countries, and policies will need to be designed to help overcome them. Moreover, countries have adopted a patchwork of different standards. Rather than adopt uniform standards, one approach could be to create Mutual Recognition Agreements (MRAs) based on tests which establish equivalence in performance. Energy efficiency testing could be a first step towards convergence.

Deepening and broadening the **energy-environment information base** in Asia is a crucial and immediate task for regional co-operation. One of the most pressing needs is to map the region's energy resources, especially renewable sources. There is also a need for more information about the sources, quantities and effects of emissions and for effective monitoring networks to be put in place.

Challenges and Opportunities

The trend towards marketisation can create an energy-security-environment nexus and policy dilemmas. To counter this, an analysis of energy-environmental market failures is required and a broad policy framework needs to be developed for regional energy co-operation.

Geography-based co-operation and globalization:
The most obvious and compelling rationale for regional energy co-operation arises when energy resources and/or energy-related environmental impacts are trans-boundary. In South Asia, there is potential for cross-border hydro development, especially between Nepal and India. In addition to primary resource development, the integration of electricity grids on a regional (or sub-regional) basis can offer economic advantages.

Geography-based incentives for regional co-operation exist regardless of the particular character of the economy. A new rationale emerges when economies are market-based and increasingly integrated. The growing openness of Asia's economies to trade and foreign investment - especially in the power sector itself - suggests that energy sector choices will be increasingly guided by domestic and global market forces. Without proper governance, however, markets have three major failings, all highly relevant to energy sustainability and security.

Energy Security Opportunities for Co-operation

Role of climate change funds for mitigation and adaptation:
The Kyoto Protocol of the UNFCCC provides mechanisms such as Joint Implementation (JI), Activities Implemented Jointly (AIJ) and Clean Development Mechanism (CDM) through which developing countries may get technologies as well as funds from developed nations for adopting means of carbon emission reductions. The South Asian region can look at how these mechanisms may be utilized for the benefit of the region as a whole and the countries in particular. A common forum for negotiating at global meets will strengthen the position of individual countries to a great extent.

South Asia energy network, an emerging opportunity - a South Asian grid:
In the South Asian region, looking at individual capabilities and potential, one feels that there is a strong case for developing a common grid that connects the countries. Although it may be expensive to link Maldives and Sri Lanka to the grid due to the fact that there are water bodies separating them from the mainland, the possibility of the five other nations getting connected to a common grid exists.

A common grid would allow for greater investment on transmission and distribution reforms that could be done across countries and thereby, lead to an improvement in the energy situation. Moreover, since Nepal and Bhutan are cash-poor but have the potential

for harnessing more power through exploitation of their hydropower sources, India, Bangladesh and Pakistan can provide them with the necessary investment support for developing their potential fully. In the process, the latter would be able to generate more power with lesser amounts of investment, since it would be cheaper to invest in commercially viable hydropower projects than install new capacity using coal-based or renewable energy technologies.

Alongside a South Asian grid, a second possible step may be in the direction of the member countries forming a cartel for all climate change issues. Within South Asia, Maldives is a vocal member of the alliance of small island states and climate change impacts may have serious consequences for this island country which is threatened by rise in sea-level. Bangladesh too has similar concerns, and India's coastline is definitely under threat from potentially adverse impacts of climate change. Creation of a **climate change adaptation and mitigation fund** would not only assist the member countries in meeting exigencies arising out of disasters caused by climate change, but also serve as a negotiating mechanism in several global fora. And last but not the least, it may facilitate the flow of funds from developed countries for mitigating or adapting to the adverse impacts of climate change through promotion of renewable technologies, technology transfer, or investment support for building up local capacity.

3.9 Co-operation in Disaster Prevention and Mitigation

The region has initiated some measures in this respect. A Panel on Tropical Cyclones has been established to fight the growing incidence of cyclones in the southern part of Asia. It includes Pakistan, India, Bangladesh, Sri Lanka and Maldives, from among the South Asian countries. Impetus towards mobilizing regional cooperation for counters disasters and hazards has also been provided by the IDNDR. Moreover, the developing countries of the region are increasingly being assisted in their efforts by bilateral donors, UN organisations and multilateral agencies such as the Asian Development Bank and the World Bank.

3.10 Bioprospecting: A Bargaining Chip in International Markets to Curtail Bio-piracy

A common problem the developing world faces today is that of bio-piracy. Multinational companies and individuals, in pursuit of their commercial gains, are plundering the biodiversity wealth of the region. They are aided in their plunder by the region's lack of effective regulation, documentation and awareness. Inspite of the obvious economic potential of medicinal plants and their wide usage, governments and countries of South Asia have been ineffective in stopping their exploitation and unscrupulous trade. To make matters worse, instead of using their rich wealth as a bargaining chip, these countries have spent enormous amounts of money for purchasing from external sources materials that were surreptitiously taken from the region itself.

In order to conserve the rich germplasm of the region, it is essential to form a regional authority for regulation of export of genetic materials. This can be further strengthened by adopting a biological diversity legislation for the region. If the region does not act now on this crucial issue, cases similar to Neem and Basmati rice will become a common affair.

3.11 Promoting Scientific and Regional Co-operation

- Establish a mechanism for bringing together people (government officials, community representatives, NGOs and academicians) from the different countries of the region to share their experiences and approaches on an annual basis. This would provide an ideal forum for exchange of success stories and failures and lay foundations for improving on the failures and replicating and building on the success stories.
- Promote regional planning practices to integrate protected areas planning and management with surrounding land use. Variation in the categories of protected areas and regional planning will enable formulation of comprehensive conservation strategies to manage protected areas more effectively, including management of fragmented habitats and corridors linking protected areas.
- Encourage and implement exchange programmes of scientific and other personnel working in the areas of integrated biodiversity conservation for formulating regional action plans.
- Encourage the preparation of innovative management plans that reflect both the conservation values of the protected areas as well as the socio-economic concerns of local communities. Emphasis should be given to concepts such as landscape and bio-regional planning in protected area systems.
- Identify trans-boundary issues related to protected areas requiring cooperative management.
- Develop the capacity of research institutions within the region to meet the requirement of research support for biodiversity conservation.

- Seek enhancement of budgetary allocations from governments by raising awareness levels among planners, decision-makers and politicians.
- Share fund-raising experiences among countries of the region to take advantage of available funds from bilateral and multilateral sources.

Initiate regional and global co-operation in sharing educational material and case studies.

4.0 Strengthening Technological Capacity

The region is facing one of the fastest growths in population, economic activity as well as pollution. Transferring state-of-the-art technologies and training people to use them is essential for meeting this three-fold challenge. Green technologies need to be used more widely throughout the industry - particularly among the small- and medium-sized enterprises (SMEs) - of the region.

The term 'green technology' does not just refer to technology that is used to treat the polluted environment. It refers to a comprehensive, all-embracing technology that allows for prevention of pollution and restoration of the damaged environment and promotes sustainable development while preserving the environment. It is regarded as a tool that enables harmony between economic growth and environmental preservation. The scope of environmental technology has been extended to include clean technology for pollution prevention, such as the invention and use of materials that cause less pollution, procedural improvements, and enhanced energy efficiency. Environmentally sound technology not only refers to each separate technique, but to the entire comprehensive system which includes know-how, processes, goods and services, facilities and organisations and management processes.

In the near future, increasing pressure on society to carve out sustainable paths of development is expected to lead public as well as private sector-led research and development institutions to develop technology solutions that would aid in better management of the environment. This will also lead the business sectors - the giant corporations as well as the SMEs - to adopt these new green technologies, either voluntarily or in compliance with a growing number of environmental regulations. Today, environmentally concerned institutions are already on the move to find ways to facilitate the transfer of green technologies from the source (e.g. developed countries) to the South Asian nations.

4.1 Parameters that Act as Barriers to Successful Technology Transfer

- Lack of information on the benefits of green technologies
- Lack of communication between national and international information systems and industry associations
- Lack of funds to facilitate technology transfer - mandates and financing of these information systems are not specifically oriented to developing countries
- Greater cost of new technologies compared to those of the existing polluting technologies
- Intellectual property rights and royalties
- Lack of skills in managing green technology in the region

4.2 Strategies to Overcome the Bottlenecks of Technology Transfer within the Region

Establishment of information dissemination centres or networks:
Establishment of country-based information access points is important. These access points have to be coordinated and networked with the other facilities for technology transfer, such as centres for training, demonstration and transfer of technology.

Information sources should be located close to end-users. This serves a two-fold purpose: it makes the end-users aware of the existence of these sources and helps them access the sources easily. Also, information should be clear and specific. It should provide focussed answers to the following: why is green technology needed, what technologies are available, their costs, benefits and drawbacks, and how and where to get them.

Technological co-operation is likely to be most successful when it takes place within a commercial setting. In such a case, both the provider and the recipient have clear, self-interested motives to make the deal successful.

Co-operation of member countries:
Co-operation among the member countries of the region could potentially reduce the costs of developing green technology. The important aspects of this cooperation could include joint research for problem solving, networking among research institutions of the region, developing regional centres that play a role in exchanging information, providing training programmes for capacity-building, and networking with international organisations.

Financial security:
Companies in the region face bigger obstacles when it comes to financing green technologies. These technologies are either unknown or not yet considered a viable approach to local industries' acute and chronic pollution problems. This is partly because very few countries in the region have demonstration projects to show what can be achieved.

Another problem is that the return on investments can take time and often companies (particularly SMEs) do not have the financial flexibility to wait for such a return. Additionally, the loans needed by many companies are simply too small to interest the major lenders.

The development banks, led by the World Bank, are supporting technology transfer in the region through policy and project lending as well as technical assistance.

Research and development:
There is need for greater coordination and direction in research and development efforts and the thrust for technology transfer from the lab to the commercial market. The problems faced in this area arise mainly due to a deficient mission-oriented approach of laboratories; inadequacy of design, engineering and fabrication facilities; insufficient funds for pilot-scale demonstration of laboratory results; and the low value placed on technology transfer by scientific and technological personnel engaged in research and development work.

5.0 Securing the Economic base

As has been enumerated in the previous sections, there are several unresolved issues confronting South Asia. The region is also suffering from a cash crunch, and every government is running a deficit. The poor financial health is as much a cause as an effect of the fast and unsustainable depletion of the natural resource base. In terms of solutions that one may search for, there are several challenges. Majority of them seem to indicate a need for greater cooperation among the member nations in order to thwart the impending financial crisis.

5.1 Strong Inter-state Trade Network for Upward Growth

The South Asian countries have broad similarities and differences. In terms of goods and services produced, while Bangladesh is a major rice bowl of the world, Pakistan produces wheat. Sri Lanka and Maldives export spices, coffee and tea, while Nepal and Bhutan are rich in biodiversity. India, by dint of its sheer size, produces all of the above, and much more. This means that there is a lot of opportunity for the member countries to develop strong trading networks. As the states are geographically close to each other, transaction costs would be minimal.

It may be mentioned here that although a lot of trade goes on - for example - between India, Nepal and Bhutan, the volume and variety of trade in general is low. The region is, as already said, the second fastest growing economic zone in the world. If there is a liberalised trading regime between these countries, the net beneficiary will be the region itself. The South Asian Preferential Trade Agreement (SAPTA) is an important step in this direction. However, it has to be more aggressive in its role. There are several suggestions to improve the situation further. One of them may be for one country to grant its trading partners in the region the 'Most Favoured Nation' status.

In addition to lowering trading costs, closer ties within an economic bloc have other positive fallouts. Let's take an example. In the present day scenario, Pakistan has a surplus of power. Bhutan and Nepal are not harnessing the full potential of their energy sector - partly because of demand side bottlenecks, and largely because of a lack of technological capacity. On the other hand, Bangladesh is deficient in energy, and India has a yawning energy gap that it cannot bridge in the next quarter of a century. If a common grid is established, it would link India with Pakistan, Nepal and Bhutan - thereby utilising their capacities better. This would enable Bangladesh and India to import power at a cheaper cost than what it would have costed them if they would have tried to raise the domestic capacity. The net beneficiary would be the regional resource base that is now made efficient use of. Eventually, this would help the region achieve energy security.

5.2 Regional Efforts to Make Industries Competitive

There is a wide variety of industries in this region. Bangladesh concentrates on textiles and fish products, Nepal and Bhutan are pioneers in the tourism industry, Pakistan exports textiles and processed foods, and Maldives and Sri Lanka sell spices and tea/coffee to the rest of the world. However, due to the broad similarities that exist in terms of climate and geo-physical conditions, there is a significant potential for adopting technological successes across countries. For example, India, Pakistan and Bangladesh have a common interest in textiles and leather. However, Pakistan leads in leather, Bangladesh has a monopoly in silk, and India exports raw cotton as well as cotton textiles. The value added to all the three countries in the event of a technology-sharing arrangement (say, in the fields of textiles and leather) across the South Asian region would be immense. It would lower production costs in the individual countries and make them more competitive globally. Most importantly, such a move would foster regional cooperation in the area and may even politically unite the countries.

5.3 A Case for Financial Integration and Stability

Having spoken of a requirement for a unified trading zone and broad-based technical co-operation within the region, the issue of financial integration of the countries is an area that requires equal attention. Presently, India, Bhutan and Nepal have a parallel system

whereby the Indian currency is honoured in commercial transactions. However, the need of the hour is to expand the base of this informal arrangement and spread it across the other members. Following the introduction of the Euro, the European Union appears to have moved a step closer towards full economic co-operation on a regional scale. It is only too well known that the developing nations are more or less discriminated against in the global market, a fact that is largely due to their poor bargaining capacity. It may be noted that prior to Maastricht, the European Common Market had been around for more than half a century without actually achieving much. The road to a real economic bloc lies in financial integration of the major economic zones - and the integration can only be brought about by a common currency.

While this does not seem to be a short-term reality, it is worthwhile to have the idea of a single currency on the agenda of the next SAARC meet. In the shorter run, observing the commendable role played by the Asian Development Bank in the direction of building up of infrastructure in the South Asian region, the creation of a South Asia Development Bank, with equity contribution from the member countries and other multilateral, bilateral and private institutions, seems to be a felt need. The Bank would focus itself totally on the needs of the region. Mobilising multilateral funds for infrastructure development is a major activity, and this can be left to the Bank to deal with.

A third issue that needs to be focussed on at this juncture is the poor state of the financial markets in the South Asian region. A large chunk of the debt market, as indeed all sorts of markets, is still totally informal. These are yet to be regulated and brought within the fold of the mainstream credit market. The impact of this 'informal' marketplace, operating in the rural sector in almost all the countries, is visible in terms of single-minded exploitation of landless labourers and the poorer farmers and artisans in the rural society - most often by the landed gentry. The harm that it does to the economy is that it takes away the capital and the surplus of the actual producer of the goods and services, so that there is little, if any, capital formation taking place in the rural sector, which is the backbone of the economy.

5.4 Bargaining with the Rest of the World against Regional Resources

This document has, in its previous sections, referred to the need for giving the South Asian zone a bargaining power in the global market. In the paragraphs above, we have focussed on the need for greater cooperation at the regional level. A unified regional economic bloc - particularly one that is as potent as South Asia - is a powerful bargaining chip. However, internally, there is a definite need to re-evaluate the resources that the region has at its disposal.

The region is immensely rich in biodiversity. Policy-makers need to realize the value of the natural habitat, and set its price accordingly. The global market of today is different from what it was: corporate leaders have understood the value of 'going green'; the environmentalist's concern is heard over and above all others'. As demonstrated by the Seattle Round of the World Trade Organisation Summit, the environment lobby is being feared, if not respected, by the global business community. With its rich storehouse of flora and fauna, and the wealth of traditional knowledge and practices under its belt, the South Asian region is in a perfect position to charge a premium for its products.

This strategy would have benefits on both sides: on one hand, it would help South Asia earn more foreign exchange. On the other, it would create the right incentives for the revival of the lost arts and crafts - by offering their practitioners higher prices. In fact, this seems to be a crucial opportunity whose doors have been opened for the South Asian countries - one which the latter can ill afford to neglect.

ANNEXURES

Appendix 1

Acronyms and Abbreviations

ACWCS	Area Cyclone Warning Centres
AFTA	Asean Free Trade Association
AIJ	Activities Implemented Jointly
APEC	Asia-Pacific Economic Cooperation Forum
BCAP	Biodiversity Conservation Plan
BODS	Biological Oxygen Demand Substances
CDM	Clean Development Mechanism
CETP	Commonn Effluent Treatment Plant
CFA	Committe On Food Aid
CNG	Compressed Natural Gas
CO	Carbon Monoxides
CO_2	Carbon Dioxide
CODS	Chemical Oxygen Demand Substances
CSE	Centre For Science And Environment
CSO	Civil Society Organisation
CWCS	Cyclone Warning Centres
EIA	Environment Impact Assessment
EMS	Environmental Management Systems
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GHG	Green House Gasses
GIS	Geographical Information System
GLOF	Glacial Lake Outburst Flood
GNP	Gross National Product
IDNDR	Inter-Disciplinary Committees For Natural Disaster Reduction
IPA	Integrated Programme Of Action
ISO	International Organisation For Standardisation
ISWM	Integrated Solid Waste Management
IT	Information Technology
IWRM	Integrated Water Resource Management
JI	Joint Implementation
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MRAS	Mutual Recognition Agreements
NGO	Non Government Organisation
NO_2	Nitrogen Dioxides
OECD	Organisation For Economic Cooperation And Development
RBO	River Basin Organisations
RS	Remote Sensing
RSMCS	Regional Specialised Meteorological Centres
SAARC	South Asian Association For Regional Cooperation
SACEP	South Asia Cooperative Environment Programme
SAFTA	South Asian Free Trade Association
SANE	Society For Andaman And Nicobar Ecology
SAPTA	South Asian Prefrential Trade Agreement
SEBS	State Electricity Boards
SMES	Small And Medium Enterprises

SO_2	Sulphur Dioxide
SO	Sulphur Monoxides
SPM	Suspended Particulate Matter
SS	Space Sciences
SSR	Self Sufficiency Ratio
TCDC	Technical Cooperation Among Developing Countries
TSP	Total Suspended Particulates
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention On Climate Change
US-AEP	United States Asia Environmental Partnership
USAID	United States Department Of Commerce
USDOC	United States Department Of Commerce
WFP	World Food Programme
WUA	Water Resource Association

Appendix 2

List of Participants in Subregional SoE Training

Regional Training Course on
Strengthening Environment Assessment and Monitoring Capabilities
in South Asia For-State of Environment Report
14 - 18 June 1999,
Kathmandu, Nepal

LIST OF PARTICIPANTS

A.N.Narayanan
Section Officer (International Cooperation)
Ministry of Environment and Forest Govt. of India
Room No. 918, Parayavaran Bhavan
CGO Complex, Lodhi Road, New Delhi - 110003
Telephone Off: 00-91-11-4363975
Telephone Res: 00-91-11-4369338
Fax 00 - 91- 11- 4362387

Bandana Pradhan Kayasta
Senior Lecturer
IOM, Community Medicine, Maharajganj T.U.
GPO Box : 5488, Kathmandu, Nepal
Telephone Off: 97 -1-412404
Telephone Res: 97 - 1 - 331625
E-mail: puba@healthnet.org.np

Bidya Banmali
Research Officer.
Tribhuvan University
RECAST.T.U. Kirtipur Kathmandu, Nepal
Telephone Off: 97 -1-331303
Telephone Res: 97 - 1 - 253044/222730

Chodhury Rudra Charan Mohanty
Senior Program officer / Head of Assessment
UNEP RRC.AP, P.O.Box:4 , Klong, Luang,
Pathumthani - 12120, Thailand
Telephone Off:66 2 - 524- 6240
Telephone Res: 66- 2- 524 - 8273
Fax: 66 - 2 516- 2125, 524- 6233
E-mail:mohyng@ait.ac.th

Kanthi De Silva
Assistant Director
Central Environmental Authority
Sri Lanka
Central Environmental Authority,
Maligawatte, Collombo 10, Sri Lanka
Telephone Off: 94 - 01- 439073/4/5
Telephone Res: 94 01 879562
Fax : 94 - 01 439076

M. Iyngararasan
Programme Specialist
UNEP RRC.AP
A.I.T,
P.O.Box:4 , Klong, Luang,
Pathumthani - 12120, Thailand
Telephone Off:66 2 - 524- 6239
Telephone Res: 66- 2- 524 - 5946
Fax: 66 - 2 516- 2125, 524- 6233
E-mail:iyngara@ait.ac.th

M.A.Kumaradasa
Deputy Director (Planning)
Ministry of Forestry and Environment
"Sampathpaya", 82 Rajamalwatta Road
Battaramulla, Sri Lanka
Telephone Off: 94 - 01- 875327
Telephone Resi: 94 01 578045
Fax : 94 - 01 878067
E-mail : forest@sri.lanka.net
SACEP

Madhav Ghimire
Joint Secretary
Ministry of Population and Environment
Singha Durbar
Telephone Off: 97 -1-241587
Telephone Res: 97 - 1 - 474448
E-mail: mope@mos.com.np

Moe Myint
GIS Specialist
MENRIS- ICIMOD
Tel: 525313, 525316
Fax: 977-1-524509/536747
Email: moe@icimod.org.np

Mozaharul Alam
Research Fellow
Bangladesh Centre for Advanced Studies (BCAS)
House No. 620 Road No. 10 A New, Dhanmondi.
Dhaka - 1209, Bangladesh
Telephone off : 880-2-815829,813977
Fax: 880-2-811344
E-mail : malam@bcas.bdonline.com,bcas@bdonline.com

Pradyumna Kumar Kotta
Project Coordinator
SACEP, # 10 Anderson Road
Colombo Sri Lanka
Telephone Off: 94 - 1 - 596443/589787
Telephone Res: 94 - 1 - 582683
Fax: 94-1-589369
E-mail: pk_sacep@eureka.lk

Pramod Pradhan
Head, MENRIS
ICIMOD
Tel: 525313, 525316
Tel: Res: 524746
Fax: 977-1-524509/536747
Email: menris@icimod.org.np

Purushottam Kunwar
Under Secretary
Ministry of Population &Environment
Singha Durbar, Kathmandu, Nepal
G.P.O.Box No: 11122, Kathmandu, Nepal
Telephone Off: 97 -1-262363
Telephone Res: 97 - 1 - 630230
Fax: 97-1-242138
E-mail: kunwar59@hotmail.com

Quazi Sarwar Imtiaz Hashmi
Deputy Director (Dev. & Planning)
Department of Environment
Govt. of Bangladesh
Department of Environment, E16
Agargaon, Sher-E-Bangla Nagar, Dhaka - 1207
Telephone Off No: 880-2-9113328
Telephone Res : 880-2-9351769
Fax: 880-2-9118682
E-mail: doe,bd@bangla.net

Subrato Sinha
Fellow
Tata Energy Research Institute (TERI).
New Delhi
Habitat Place, Lodhi Road
New Delhi - 110003
Telephone Off: 00-91-11- 4622246
Telephone Res: 00-91-11-5111399
E- mail: subratas@teri.res.in

Appendix 3

Sub-regional consultations at Colombo

Consultations on State of the Environment (SoE) Report for South Asia
28 June 2001
Colombo, Sri Lanka

List of Participant

Ananda Raj Joshi
Director General,
South Asia Cooperative Environment Programme (SACEP)
#10 Anderson Road, Colombo 5, Sri Lanka
Tel1: 94-1-589376/ 589787, Fax: 94-1-589369
Email: aj_sacep@eureka.lkV

Avanish Kumar
Anthropologist, Environment Systems Branch,
Development Alternatives (DA)
B-32, TARA Crescent, Qutab Institutional Area,
New Delhi-110016, India
Tel: 91-11-6967938, 6851158, 6565370
Fax: 91-11-6866031
Email: avanish@sdalt.ernet.in
avanishkumar@usa.net

Bandana Kayastha Pradhan
Consultant, MENRIS
International Centre for Integrated Mountain
Development (ICIMOD),
G.P.O.Box 3226, Kathmandu, NEPAL.
Tel: 977-1-525313(Off.) 410268 (Res.),
Fax: 977-1-524509
Email: bandana@icimod.org.np

Bidya Banmali Pradhan
Consultant, MENRIS
International Centre for Integrated Mountain
Development (ICIMOD),
G.P.O.Box 3226, Kathmandu, NEPAL.
Tel: 977-1-525313(Off.) 253044 (Res.)
Fax: 977-1-524509
Email: bidya@icimod.org.np

Chodhury Rudra Charan Mohanty
Senior Program officer / Head of Assessment
Room 304, Outreach Building,
UNEP RRC.AP , Asian Institute of Technology
P.O. Box 4, Klong Luang, Pathumthani 12120 Thailand
Tel: 662-524-6240 Fax: 516-2125, 524-6233
Email: mohyng@ait.ac.th

Charu Jain
Environmental Scientist, Environment Systems Branch,
Development Alternatives (DA)
B-32, TARA Crescent, Qutab Institutional Area,
New Delhi-110016, India
Tel: 91-11-6967938, 6851158, 6565370
Fax: 91-11-6866031
Email: charu@sdalt.ernet.in

Govind R. Bhatta
Former Secretary,
Ministry of Population & Environment
Singh Durbar, Kathmandu, Nepal
Fax: 977-1-242 138
Tel: 977-1-241586
Email: mailto:drgrbsms@hotmail.com

K. Vijaya Lakshmi
Manager, Environment Systems Branch,
Development Alternatives (DA)
B-32, TARA Crescent, Qutab Institutional Area,
New Delhi-110016, India
Tel: 91-11-6967938, 6851158, 6565370
Fax: 91-11-6866031
Email: KONERUVL@yahoo.com

Karma L. Rapten
Program Officer, National Environment Commission
Post Box No. 466, Thimphu, Bhutan
Tel: (975-) 323 384/324323
Fax: (975-2) 2 323 385
Email: eanec@druknet.net.bt

M. A. Kumaradasa
Director Policy Planning
Ministry of Forestry and Environment
"Sampathpaya", No. 82, Rajamalwatta Road
Battaramulla, Sri Lanka
Tel: (94-1) 883099, Fax: (94-1) 877 292
Email: mofe-forest@eureka.net

Md. Atiqul Islam Chowdhury
Joint Secretary (Development)
Ministry of Environment & Forest,
Bangladesh Secretariat
Dhaka - 1000, Bangladesh
Tel: (88-02) 861 9621, 861 0856
Fax: (88-02) 861 9210, 861 0166

Mehboob Elahi
South Asia Cooperative Environment Programme (SACEP)
#10 Anderson Road, Colombo 5, Sri Lanka
Tel1: 94-1-589376/ 589787, Fax: 94-1-589369
Email: aj_sacep@eureka.lk

Mohammad Shawkat Ali
Senior Assistant Secretary
Ministry of Environment and Forest
Room# 1330 Building 3 Building# 06
Bangladesh Secretariat, Dhaka Bangladesh
Tel: 8802 8610551 Fax: 8802 8619210
Email: warf@agni.com

Mylvakanam Iyngararasan
Senior Programme officer
Room 304, Outreach Building,
UNEP RRC.AP
Asian Institute of Technology
P.O. Box 4, Klong Luang, Pathumthani 12120 Thailand
Fax: 662 516 2125 Tel: 662 524 6239
E Mail: iyngara@ait.ac.th

Nedup Tshering
National Environment Commission,
P.O. Box 466, Thimphu, Bhutan
Fax: 975-2-323385
Tel: 975-2-323384
E Mail: Nedup@hotmail.com

Parvin Maroufi (Ms.)
Director General
Public Relations & International Affairs
Department of the Environment
No. 187 Ostad Nejatollahi Ave., P. O. Box 15875 IR
Tehran, The Islamic Republic of Iran
Tel: (98 21) 890 3720, 890 3724, 890 8246
Fax: (98 21) 890 8230
Telex: 215064 DOEC IR
Email: maroofi@IRAN DOE.ORG

Pradyumna Kumar Kotta
Project Coordinator,
South Asia Cooperative Environment Programme
#10 Anderson Road, Colombo 5 Sri Lanka
Fax: 94-1-589369 Tel1: 94-1-589787, Tel2: 94-1-596443
E-Mail: pk_sacep@eureka.lk

Purna Chandra Lall Rajbhandari
Program Officer,
Room 304, Outreach Building,
UNEP RRC.AP,Asian Institute of Technology
P.O. Box 4, Klong Luang,
Pathumthani 12120, Thailand
Fax: 662 516 2125, Tel: 662 524 6238
E-Mail: rajbhandari@ait.ac.th, purna_rajani@hotmail.com

Purushottam Kunwar
Under Secretary,
Ministry of Population and Environment
Singha Durbar, Kathmandu, Nepal
Tel: 977-1 262363
Fax: 977-1 242138
Email: kunwarp@hotmail.com

Quazi Sarwar Imtiaz Hashmi
Deputy Director (Dev. & Planning)
Department of Environment
Paribesh Bhaban, Room No. 101
E-16, Agargaon, Sher-E-Bangla Nagar
Dhaka-1207, Bangladesh.
Fax: 880-2-9118682/ 9124005

R. Rajamani, IAS

Ex-Secretary, MoE & F,
8-2-585/A/1, Road No. 9
Banjara Hills, Hyderabad - 500034, India
Tel: (91-40)-335 8320
Fax: (91-40)-335 5480
Email: rraja@universe.uohya.ernet.in

S.K. Joshi
Director, (International Cooperation)
Ministry of Environment and Forests,
Paryavaran Bhawan, CGO Complex, Lodi Road,
New Delhi - 110003, India
Tel: (91-11)- 436-2387 (Off), 436-1419(Res)
Fax: (91-11)-436-2387
Email: skjoshi@menf.delhi.nic.in

Saeed Ather
Section Officer
Ministry of Environment, Local Government and Rural Development
Room No. 408, Shaheed Millat Sectt
Islamabad, Pakistan
Tel: 9204491, 9202574 Fax: 9202211

Surendra Shrestha
Director
Room 304, Outreach Building,
UNEP RRC.AP
Asian Institute of Technology
P.O. Box 4, Klong Luang, Pathumthani 12120 Thailand
Fax: 662 516 2125 Tel: 662 516 2124
E Mail: Surendra@ait.ac.th

Thosapala Hewage
Additional Secretary
Ministry of Forestry and Environment
"Sampathpaya", No. 82, Rajamalwatta Road
Battaramulla, Sri Lanka
Tel: (94-1) 868 048, 866 612, 877 290,
Fax: (94-1) 877 292
Email: mofe-forest@eureka.net

Tunnie Srisakulchairak
Research Associate,
Room 304, Outreach Building,
UNEP RRC.AP ,Asian Institute of Technology
P.O. Box 4, Klong Luang, Pathumthani 12120 Thailand
Tel: 662 524 6220 Fax: 662 516 2125,
E-Mail: tunnie@ait.ac.th

Appendix 4

List of contributers and reviewes

Abhijit Chaterjee
Environmental Economist, DA

Aditi Halder
Senior Environmental Scientist, DA

Anand Kumar
DA

Ananda Raj Joshi
DirectorGeneral, South Asia Cooperative Environment Programme (SACEP)

Anita Khanna
DA

Avanish Kumar
Anthropologist, DA

Bandana Kayastha Pradhan
Consultant, MENRIS International Centre for Integrated Mountain Development (ICIMOD)

Bhairab Giri Goswami
DA

Bidya Banmali Pradhan
Consultant, MENRIS International Centre for Integrated Mountain Development (ICIMOD)

Charu Jain
DA

Col. V Katju
Manager, Environment Monitoring Facility, DA

Chodhury Rudra Charan Mohanty
Senior Program officer / Head of Assessment, UNEP RRC.AP

Dhiraj Manhas
Environmental Scientist, DA

Dhirendra Kumar Jha
Environmental Engineer, DA

George C Varughese
Vice President, Environment Systems Branch, DA

Govind R. Bhatta
Former Secretary, Ministry of Population & Environment

Gunjan Doogar
Environmental Scientist, DA

K Vijaya Lakshmi
Manager, Environment Systems Branch, DA

Kalipada Chatterjee
Manager, Global Environment Systems Branch, DA

Karma L. Rapten
Program Officer, National Environment Commission

Lata Raman
Environmental Scientist, DA

M. A. Kumaradasa
Director Policy Planning Ministry of Forestry and Environment

Manisha Gopalakrishnan
Environmental Scientist, DA

Md. Atiqul Islam Chowdhury
Joint Secretary (Development) Ministry of Environment & Forest, Bangladesh Secretariat

Meenakshi Rawat
DA

Mehboob Elahi
South Asia Cooperative Environment Programme (SACEP)

Mohammad Shawkat Ali
Senior Assistant Secretary Ministry of Environment and Forest

Mylvakanam Iyngararasan
Senior Programme officer UNEP RRC.AP

Nedup Tshering
National Environment Commission

Nishant Bharadwaj
Environmental Scientist, DA

Parvin Maroufi (Ms.)
Director General Public Relations & International Affairs Department of the Environment

Pradyumna Kumar Kotta
Project Coordinator, South Asia Cooperative Environment Programme

PSC Rao
Senior Natural Resource Scientist , DA

PSC Rao
Senior Natural Resource Scientist , DA

Purna Chandra Lall Rajbhandari
Program Officer UNEP RRC.AP

Purushottam Kunwar
Under Secretary, Ministry of Population and Environment

Quazi Sarwar Imtiaz Hashmi
Deputy Director (Dev. & Planning) Department of Environment

Rajamani (Retd. IAS)
Ex. Secretary, Ministry of Environment and Forests, India

Rajani Nayal
DA

Ruchika Aggarwal

S Karthik
Environmental Engineer, DA

S.K. Joshi
Director, (International Cooperation) Ministry of Environment and Forests

Saeed Ather
Section Officer Ministry of Environment, Local Government and Rural Development

Sanjay Vashist
Natural resource Scientist, DA

Sonika
DA

Souparno Banerjee

Surendra Shrestha
Director UNEP RRC.AP Asian Institute of Technology

T N Anuradha
Environmental Scientist, DA

Thosapala Hewage
Additional Secretary Ministry of Forestry and Environment

Tunnie Srisakulchairak
Research Associate

V K Sharma
National Centre For Disaster Management, New Delhi

Vivek Kumar
Environmental Scientist, DA