

South Asia Environment Outlook 2009



UNEP

United Nations Environment Programme



SAARC

South Asia Environment Outlook 2009



Disclaimers

The content and views expressed in this publication do not necessarily reflect the views or policies of the contributory experts, organizations. United Nations Environment Programme (UNEP), South Asian Association for Regional Cooperation (SAARC) and Development Alternatives (DA) neither do they imply any endorsement.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of UNEP, SAARC and DA concerning the legal status of any country, territory, or city or its authorities, or concerning the delimitation of its frontiers and boundaries.

The mention of a commercial company or product in this publication does not imply the endorsement of UNEP, SAARC and DA.

© Maps, photos and illustrations as specified.

Citation

United Nations Environment Programme and Development Alternatives (2008)

South Asia Environment Outlook 2009: UNEP, SAARC and DA.

Reproduction

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder, provided acknowledgement of the source is made. UNEP, SAARC and DA would appreciate receiving a copy of any publication that uses this publication as a source.

No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from UNEP, SAARC and DA. Applications for such permission, with a statement of purpose and intent of the reproduction, should be addressed to UNEP.

The use of information from this publication concerning proprietary products for publicity or advertising is not permitted.

Cover photographs: from top Atif Gulzar, Philip Niewold, Unlisted Images Inc

Produced by:



United Nations Environment Programme

P.O. Box 30552, Nairobi 00100

Kenya

Tel: (+254) 20 7621234. Fax: (+254) 20 7623927

E-mail: unepubb@unep.org

Web: www.unep.org

Graphic and Layout: Motilal B. Soni

Printed on 100% recycled papers with vegetable ink.

UNITED NATIONS ENVIRONMENT PROGRAMME

The Mission of the United Nations Environment Programme is to provide leadership and encourage partnership in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations.

SOUTH ASIAN ASSOCIATION FOR REGIONAL COOPERATION

The South Asian Association for Regional Cooperation (SAARC) provides a platform for the peoples of South Asia to work together in a spirit of friendship, trust and understanding. It aims to accelerate the process of economic and social development in Member States.

DEVELOPMENT ALTERNATIVES

Development Alternatives is a social enterprise dedicated to sustainable national development. Its mission is to create sustainable livelihoods on a large scale. Its strategy is to innovate and deliver market based technologies and institutions that improve the lives of common people and the health of their environment.

UNEP promotes environmentally sound practices globally and in its own activities. This magazine is printed on 100% recycled paper, using vegetable-based inks and other eco-friendly practices. Our distribution policy aims to reduced UNEP's carbon footprint.

Foreword



UNEP

United Nations Environment Programme

Among the ways that the United Nations Environment Programme (UNEP) fulfils its mandate to keep the state of the global environment under review is through the Global Environment Outlook (GEO) process. The GEO process provides scientifically credible and timely information for environmental policy development and management through global, regional, sub-regional, national and city-level assessment processes. The process is participatory and consultative, and features capacity building at its core, in line with the Bali Strategic Plan for Technology Support and Capacity Building, an agreed intergovernmental framework to strengthen capacity in developing countries and countries with economies in transition on a wide range of environmental issues.



In collaboration with South Asian Association of Regional Cooperation (SAARC), the South Asia Environment Outlook 2009 (SAEO-2009) is the result of a consultative process with governments and other partners from the nations of South Asia, sub-regional intergovernmental agencies and experts. This report provides an overview of the state of the natural environment in South Asia, including emerging trends, taking into account socio-economic factors.

South Asia occupies about 5 per cent of the world's land mass, but is home to about 20 per cent of the world's population. This is expected to rise to about 25 per cent by 2025. Three-quarters of South Asia's population lives in rural areas, with one-third living in extreme poverty (on less than a dollar a day). Their well-being is further compromised by indoor air pollution, which is a severe health hazard.

The report concludes that South Asia is very vulnerable to climate change. Impacts of climate change have been observed in the form of glacier retreat in the Himalayan region, where the approximately 15,000 glaciers will likely shrink from the present total area of 500,000 km² to 100,000 km² by 2035. These glaciers form a unique reservoir, which supports perennial rivers such as the Indus, Ganges and Brahmaputra, which, in turn, are the lifeline of millions of people in South Asian countries (Bangladesh, Bhutan, India, Nepal, and Pakistan). This will exacerbate the challenges of poverty reduction and improving access to safe drinking water, two of the Millennium Development Goals.

The SAEO-2009 report also highlights opportunities for action. These include focusing on a range of response options and instruments to address these challenges and emphasizing the need for increasing responsibilities and greater cooperative efforts by all stakeholders. Increased awareness of ecosystem services and new market-based management systems are recommended as important mechanisms to mainstream environment into social and economic development processes in the sub-region.

I hope the report will provide a sound basis for policy making as SAARC and its member countries respond to the challenges of sustainable development in the 21st century.

Achim Steiner

United Nations Under-Secretary
General and Executive Director
United Nations Environment Programme

Foreword



SOUTHASIAN ASSOCIATION FOR REGIONAL COOPERATION SECRETARIAT

I am pleased to note that the South Asia Environment Outlook (SAEO) 2009 is being published by the United Nations Environment Programme (UNEP) with technical assistance from Development Alternatives, New Delhi. As a collaborative endeavour of the South Asian Association of Regional Cooperation (SAARC) and UNEP, this publication provides a very useful account of the state of the environment in South Asia, the challenges faced as well as the various initiatives being pursued to protect, preserve and manage the diverse and fragile ecosystems of the region.



Preservation and protection of the environment remains a high priority on the agenda of cooperation being pursued by the Member States of SAARC. The imperative of environmental conservation and management has been recognized and underscored by the Leaders of SAARC at successive Summits. Indeed, the directives issued by successive SAARC Summits provide continued impetus for strengthening and intensifying regional cooperation in this vital field.

Today, in addition to the endeavours being pursued at the national level by the governments of Member States, there are a number of initiatives taken by SAARC at the regional level. The 1997 SAARC Plan of Action on Environment and the 2008 Dhaka Declaration and Action Plan on Climate Change are some of the most significant initiatives taken to strengthen regional cooperation in a comprehensive manner in the environment field. Furthermore, the Ministerial Meetings on Environment and the Technical Committee on Environment and Forestry periodically review progress and guide and steer collaborative endeavours at the regional level. The establishment of a number of Regional Centers such as the SAARC Meteorological Research Centre in Bangladesh, the SAARC Coastal Zone Management Centre in the Maldives, the SAARC Disaster Management Centre in India and the SAARC Forestry Centre in Bhutan constitute a framework of SAARC Institutions which address diverse aspects of environment. These initiatives and mechanisms demonstrate the high priority attached to environmental conservation and sustainable development by the Member States of SAARC.

SAARC formalized its collaboration with UNEP with the signing of a MoU in June 2007. SAEO 2009 encapsulates our engagement with UNEP and we are confident that SAARC-UNEP cooperation will continue to grow in the coming years. SAEO 2009 provides important insights on the challenges that South Asia faces and will serve as a useful document to gauge and measure progress being achieved in our concerted endeavours to pursue sustainable development for the well-being of present and future generations in South Asia. I wish to commend UNEP for bringing out this important publication with the gracious help of Member States.

Dr. Sheel Kant Sharma
Secretary General of SAARC

Acknowledgements



United Nations Environment Programme (UNEP) and South Asia Association of Regional Cooperation (SAARC) acknowledge the contributions made by many governments, individuals and institutions in the preparation and publication of the South Asia Environment Outlook (SAEO) 2009. The partners would also like to acknowledge and thank the Government of Norway which provided Funding from through a UNEP –Norway Development Partnership, in addition to the UNEP Environment Fund supported to the SAEO preparation process and report.

A full list of names of individuals and institutions involved in the assessment process is included in page 129 onwards

Special Thanks are extended to:

Development Alternatives Team

George C. Varughese
Dr. K. Vijaya Lakshmi
Anand Kumar
Ridhima Sud

SAARC Team

Pema L. Dorji
Sonam Tshong

UNEP Team

Anna Stabrawa
Jinhua Zhang
Subrato Sinha
Purna Chandra Lall Rajbhandari

Contents



	Executive Summary	
	Introduction	2
	Regional Overview	3
	State and Trends of the Natural Environment	8
	Land	9
	Air	17
	Water	24
	Biodiversity	30
	Priorities for South Asian Cooperation	44
	Climate Change	45
	Food Security	61
	Water Security	70
	Energy Security	81
	Managing Urbanization	89
	Policy and Institutional Options	97
	Building Awareness	98
	Participatory Management	106
	Technology Transfer	108
	Trade and Investments	111
	Ecosystem Services	116
	Annexures	122
	Acronyms	122
	List of Boxes	125
	List of Figures	126
	List of Tables	128
	List of Consultation Workshop Participants	129

Executive Summary



Among the ways that the United Nations Environment Programme (UNEP) fulfils its mandate to keep the state of the global environment under review is through the Global Environment Outlook (GEO) process. The GEO process provides scientifically credible and timely information for environmental policy development and management through global, regional, sub-regional, national and city-level assessment processes. The process is participatory and consultative, and features capacity building at its core, in line with the Bali Strategic Plan for Technology Support and Capacity Building, an agreed intergovernmental framework to strengthen capacity in developing countries and countries with economies in transition on a wide range of environmental issues.

In collaboration with South Asian Association of Regional Cooperation (SAARC), the South Asia Environment Outlook 2009 (SAEO-2009) is the result of a consultative process with governments and other partners from the nations of South Asia, sub-regional intergovernmental agencies and experts. This report provides an overview of the state of the natural environment in South Asia, including emerging trends, taking into account socio-economic factors.

The South Asia Environment Outlook 2009 covers the state and trends of the environment (land, air, water, biodiversity) and five key issues - (1) Climate Change, (2) Food Security, (3) Water Security, (4) Energy Security, and (5) Managing Urbanization. South Asia occupies about 5 per cent of the world's land mass, but is home to about 20 per cent of the world's population. This is expected to rise to about 25 per cent by 2025. Three-quarters of South Asia's population lives in rural areas, with one-third living in extreme poverty (on less than a dollar a day). Their well-being is further compromised by indoor air pollution, which is a severe health hazard. The report highlights that South Asia is very vulnerable to climate change. Impacts of climate change have been observed in the form of glacier retreat in the Himalayan region, where the approximately 15,000 glaciers will likely shrink from the present total area of 500,000 km² to 100,000 km² by 2035. These glaciers form a unique reservoir, which supports perennial rivers such as the Indus, Ganges and Brahmaputra, which, in turn, are the lifeline of millions of people in South Asian countries (Bangladesh, Bhutan, India, Nepal, and Pakistan). This will exacerbate the challenges of poverty reduction and improving access to safe drinking water, two of the Millennium Development Goals.

The SAEO-2009 report also highlights opportunities for action. These include focusing on a range of response options and instruments to address these challenges and emphasizing the need for increasing responsibilities and greater cooperative efforts by all stakeholders. Increased awareness of ecosystem services and new market-based management systems are recommended as important mechanisms to mainstream environment into social and economic development processes in the sub-region.

The report is structured into five sections:

Section – I presents profile of South Asia in brief with characteristics of bio-physical profile, socio-economic and cultural pattern, biodiversity, climate and economic base.

South Asia is home to one of the oldest civilizations of the world. The sub-region includes the countries with "Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka". It has a 1.5 billion strong population growing at the rate of 1.8% per annum but has only 4.8 per cent of the world's total land area. South Asia's topography includes an amazing variety of mountains, plateaus, dry regions, intervening structural basins and beaches. It varies from world highest point, Mount Everest to the world lowest, the sea beach. The entire coastline runs to about 10,000 km from Pakistan to Bangladesh, with wetlands occupying an area of 1,34,161 sq km. The region is characterized by a tropical monsoon climate. Two monsoon systems operate in the region: the southwest or summer monsoon (June-September) and the northeast or winter monsoon (December-April). This region also features large year-to-year variations in the rainfall frequently causing severe floods/droughts over large areas. Some of the world's largest river systems are in the South Asia. The River Indus originates in China and flows to Pakistan. The Ganga-Brahmaputra river systems originate partly in Bhutan, China and Nepal and flow to Bangladesh and India. The Indus is one of the world's greatest river systems, measuring 3,180 km, from its source to the sea. The Ganga stretches for about 2,525 km and the Brahmaputra – the third great Himalayan River, stretches for about 2,900 km flowing through Tibet, India and Bangladesh. South Asia displays a multitude of cultures, in which people from different races and religions co-exist. Besides the sociocultural groups that are native to the region (such as Buddhists and Jains), it also shelters groups who have either, immigrated to the land or have come in contact with it. The South Asian region is a key economic zone, as seen from the global perspective. It assumes prime importance due to two fundamental reasons. South Asia's robust economic performance, supported by sustained growth in industry and service sectors, is expected to continue in 2006, with an average growth rate at 6.6 per cent. The improved overall economic performance of the region, to a large extent, reflects structural reform and liberalization policies being adopted by most South Asian countries, from the mid-eighties. Such reforms encouraged market forces and the private sector to play a more prominent role in driving the economies, compared with the State-led development model of the sixties and seventies.

Section – II presents the state of environment & trends and integrated analyses of four major themes (Land, Air, Water and Biodiversity). The state and trends have been analyzed under the Pressure-State-Impact-Response (PSIR) framework

Land

South Asian economies are mainly based on agriculture and therefore, land is an important resource. The region that occupies 4.8 per cent of the world's total land area, displays an extraordinary diversity of landforms due to climatic regimes, latitudes, altitudes and topography. Land, in South Asia, is under immense pressure as agriculture, urban land and wild areas all compete for the same resource. The demand for land has increased, along with the intensity of land use, and this combination culminates in environmental damage and the degradation of land quality. Land degradation is a major problem in all South Asian countries. Degradation caused by water is perhaps the greatest challenge facing South Asia, as many areas have periods of high rainfall and steep mountainous regions. Modern methods of agriculture have contributed to land degradation, with practices such as overuse of fertilizers and pesticides, excessive irrigation of saline lands and shifting agriculture. The strategies identified to check land-degradation are as follows:

- Development and implementation of national land use policies
- The widespread rural infrastructure development should be accelerated to mitigate increased urban migration
- Reforestation programmes and declaration of protected areas
- Integrated watershed management
- Integrated rural development
- Integrated coastal area and river basin management
- Building awareness and local capacity
- Investments in research and development to develop and disseminate alternative techniques of soil conservation such as Sloping Agriculture Land Technology (SALT)

Air

High levels of urban air pollution have attracted growing attention from the government, civil society, and industry in South Asian countries. Poor air quality threatens human health and causes other forms of environmental damage. With continuing migration from rural to urban areas, air pollution will affect an increasing percentage of the urban population in the coming years. Urban growth and industrialization in South Asia have caused air pollution to become a problem of real concern. This is true of urban areas, where transport is the largest source of pollution; others include energy generation and industry. Air quality has been, therefore, an issue of concern in the backdrop of various developmental activities. Some of the recommendations made to reduce air pollution are as follows:

- An integrated air quality plan that encompasses various factors such as proper fuel policy, transport policy and traffic management needs to be put in place in South Asian countries to effectively address the problem of deteriorating air quality.
- Stringent checks need to be enforced on industrial pollution.
- Air quality standards should be strictly adhered to and pollution control devices used for the purpose
- The “Malé Declaration” on control and prevention of trans-boundary air pollution and its likely trans-boundary effects for South Asia is a good example of tackling trans-boundary air pollution through regional cooperation

Water

Freshwater is a finite, renewable yet vulnerable natural resource catering to needs of multiple stakeholders for a range of purposes such as domestic water supply, irrigation, hydropower, and industrial production. The Hindu Kush-Himalayan region (HKH) is one of the largest storehouses of fresh water in the world, and its mountains are the source of major river systems that serve million people in South Asia. However, access to clean water remains one of the major challenges for the region, even though the water availability is high. This is partly due to the seasonal nature of the water supply, and largely because of degrading water quality.

Biodiversity

South Asia is renowned for its spectacular natural beauty and biological wealth. The region’s geographical expanse and topography include several diverse ecosystems that harbour a rich variety of faunal and floral species. The Sunderbans, in India and Bangladesh, form the largest contiguous mangrove swamp in the world. Three rich biodiversity hotspots are: in the eastern Himalayas in Nepal, northeastern India, and Bhutan; the Western and Eastern Ghats of India and Sri Lanka; and the Indo-Burma hotspot in India and Myanmar. The factors contributing to loss of biodiversity are habitat destruction, deforestation, loss of wetlands, population growth and climate change.

- At the regional level, the United Nations Environment Programme (UNEP), in collaboration with the South Asia Cooperative Environment Programme (SACEP) and governments in the region, has initiated the South Asian Seas Regional Programme, to promote protection of the marine environment and sound management of the South Asian seas
- Creation of Biodiversity Corridors Conservation Initiative for South Asia is a positive step in providing safe transit for migratory species
- Formulating a South Asian Biodiversity Conservation Agreement would facilitate more detailed assessments, mapping and delineation of protected areas; revival of traditional conservation knowledge; curtailment of bio-piracy; setting up of domestic and joint venture manufacturing units; and facilitate trade in finished products rather than raw materials

Section – III focuses on key environmental issues i.e. Climate Change, Food Security, Water Security, Energy Security and Urbanization that threaten to cripple the efforts towards holistic development of South Asia. The issues are again analyzed under the Pressure-State-Impact-Response (PSIR) framework.

Climate Change

Global climate change is a natural phenomenon; it is well known that the earth's average surface temperature has been increasing since the end of the Little Ice Age. The most well known anthropogenic cause of global warming is Green House Gas (GHG) emissions, in recent years. Warming may induce sudden shifts in regional weather patterns like monsoons or the El Niño. Such changes would have severe consequences for water availability and flooding in tropical regions and their livelihoods South Asian countries are particularly at risk. The impacts result not only from gradual changes in temperature and sea level rise but also, in particular, from increased climate variability and extremes, including more intense floods, droughts, and cyclones. These changes have had impacts on economic performances of South Asian countries and the lives of millions of the poor. It also puts at risk infrastructure, agriculture, human health, water resources, and the environment. South Asian nations have started to face the effects of Climate Change. All the nations of the sub-region are threatened by effects of climate change.

A major concern in South Asia is the lack of knowledge and awareness on climate change as well as the lack of necessary resources to assess the possible impacts. There is a need for research on localized climate changes and its impacts. The focus is on promoting understanding of Climate Change, adaptation and mitigation, energy efficiency and natural resource conservation

Food Security

Food security is among the most pressing challenges faced by South Asia. It is of prime importance in the present day scenario, in view the high rate of population growth, high concentration of poor households and low per capita income, in spite of a reasonable rate of GDP growth prevalent in the countries of South Asia. Most of the poor in South Asia are dependent on agriculture for their livelihood and survival. Approximately, 60 per cent of the labour force is involved in agriculture and the sector accounts for 23 per cent of GDP (IFPRI).

Change in food consumption, poverty, land degradation, intensive farming, climate change and disasters are some of the pressures for food insecurity. Some of the measures to secure food security are as follows:

- Sustainable intensification and diversification of farming systems and value-addition
- Strengthening infrastructure and delivery systems
- Reviving rural infrastructure
- The policy priorities for improving food security and nutrition in South Asia include greater public investment in agriculture as well as in the social sectors
- Institutions could also play an important role in improving access to food. Well functioning institutions that facilitate the smooth transfer of produced food to consumers are important

Water Security

Water security is emerging as an increasingly important and vital issue for the South Asian region. Many South Asian countries are beginning to experience moderate to severe water shortages, brought on by the simultaneous effects of agricultural growth, industrialization and urbanization. Another concern in the region is growing competition over shared water resources. These shortages would be further aggravated by receding of glaciers and dwindling fresh water resources. Water stress is likely to be a major impact of climate change, with some of South Asia's major rivers such as the Indus and Brahmaputra projected to fall by as much as a quarter. Some of the measures to enhance water security are:

- Formulation of water Policies: 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.
- 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

Energy Security

South Asia accounts for about 5.9 per cent of the world's commercial energy consumption. This does not include the non-commercial energy sources such as wood, animal waste and other biomass that account for more than half of the region's total energy consumption. Despite rapid rise in demand, South Asia continues to average among the lowest per capita energy consumption of 443 kilogram of oil equivalent (KgoE), which amounts to 26.2 per cent of the world average of 1692 KgoE. However, energy consumption per dollar of GDP is amongst the highest in the world, which indicates the inefficient utilization of energy. Some of the measures to increase energy security are:

- Creation of a South Asian energy market and cooperative development of the available diverse energy sources in the region.
- Subsidy reforms for sustainable development
- Utilization of renewable sources of energy for power generation
- Developing a South Asian Energy Alliance

Managing Urbanization

South Asia is experiencing a major demographic transition. Its expanding urban areas face a complex set of challenges that must be overcome if they are to fulfil their potential as hubs for economic, social and political innovation and leadership. The growing urbanization has led to unchecked construction of houses without integrating environmental aspects related to siting, construction materials, etc. The demand of the construction sector on natural resources leads to injudicious extraction from rivers, quarries and clay pits. Some of the pressures are Spiralling population growth rates, Squatter settlements and lack of basic amenities.

Section – IV provides the Policy and Institutional Options to cater the emerging environmental challenges. To address these challenges, it is essential to focus on diverse response options and instruments for possible solutions. Emphasis must be placed on increasing stakeholder's responsibility and accountability and promoting more cooperative efforts for ensuring a healthy environment. Spreading awareness and empowering people to take decisions, at the local level, is an effective way of dealing with the environmental problems of South Asia. Their decisions will enable initiatives that will benefit them as well as the local environment. It has been seen that solutions always emerge whenever governments involve people, using a participatory approach to solve problems. Community-based natural resource management initiatives, coupled with policy reforms, can prove to be an effective mechanism for improving access to, and improving productivity of, natural resources. Increased awareness of ecosystems and new market based systems will prove to be important mechanisms in dealing with environment issues.





Introduction

South Asia comprises of three per cent of the world's land mass. The region's geographical expanse includes a variety of mountains, plateaus, dry regions, river basins and beaches. The region is an amalgamation of myriad, multicultural ethnic, religious or linguistic groups that have a common bond to their own heritage, culture, values and ways of life.

Although the total land area comprises only about three per cent of the world's land mass, it is inhabited by one-fifth of the world's population and is a key economic zone, as seen from the global perspective.

Regional Overview



South Asia is home to one of the oldest civilizations of the world. The sub-region includes the countries with "Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka". It has a 1.5 billion strong population growing at the rate of 1.8% per annum but has only 4.8 per cent of the world's total land area. South Asia's economy expanded by 8.7% in 2006, supported by growth in consumption and investment. The region has averaged more than 7.5% growth since 2003, allowing it to reduce poverty levels in India, Pakistan, and Bangladesh. Despite the economic progress, 430 million people in South Asia, live on less than US\$1.00 per day and with its GNI per capita at US\$594 in 2004, is home to 47 per cent of the world's poor. Multiple stress of accelerating population growth rates, rising poverty and inequality, large scale rural to urban migrations and dwindling resource base are contributory factors causing destruction of fragile ecosystems making it an issue of priority demanding immediate attention.

Physiography and relief

The sub-region is bound in the south by the Indian Ocean, in the southeast by the Bay of Bengal, in the southwest by the Arabian Sea and in the north by the Himalayan Mountains. 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 the region as determined by climate, water, geology, soil and diverse topography. South Asia's topography includes an amazing variety of mountains, plateaus, dry regions, intervening structural basins and beaches. It varies from world highest point, Mount Everest to the world lowest, the sea beach. The entire coastline runs to about 10 000 km from Pakistan to Bangladesh, with wetlands occupying an area of 134 161 sq km.

Climate

The region is characterized by a tropical monsoon climate. Differences in rainfall are of primary significance in defining the climate of the region. The most important feature is the seasonal alteration of atmosphere flow patterns, associated with the monsoon. Two monsoon systems operate in the region: the southwest or summer monsoon (June-September) and the northeast or winter monsoon (December-April). The rainfall during the summer monsoon largely accounts for the total annual rainfall over most of South Asia (except over Sri Lanka, where rainfall of the winter [northeast] monsoon is dominant); and forms a chief source of water for agriculture and other activities. The monsoon rainfall in South Asia is characterized by large spatial and temporal variability. The arid and semi-arid region encompassing Pakistan and northwest India receive monsoon rainfall as low as 50 mm while parts of northeast India and the west coast receive over 1 000 mm. This region also features large year-to-year variations in the rainfall frequently causing severe floods/droughts over large areas. There are two major anomalous regions: the arid and semi-arid parts comprising of large areas of Pakistan and northwestern Indian states (Rajasthan, Punjab, Haryana and Gujarat) which experience frequent droughts; and the eastern Himalayan

sub-region, fed by the Ganga-Brahmaputra-Meghna river systems, which are cause of frequent floods.

In India, during the period between 1871 and 2000 there were 22 drought years and 19 flood years. There had been three cases of prolonged drought conditions in 1904-05, 1965-66 and 1985-87, which caused great anguish. Similarly, there had been two cases of prolonged flood conditions in 1892-94 and 1916-17. Studies indicate a clear relationship between the occurrence of droughts and floods in South Asia with El Niño (La Niña) events in the East Pacific Ocean. It has been observed that, during the period 1856-1997, there were 30 El Niño years in which the average monsoon rainfall over India was

seven per cent below normal; and in 10 of these 30 cases, drought conditions prevailed over India. During the same period there were 16 La Niña years, nine of which featured flood conditions over India, particularly in 1878 and 1983. However, it appears from some of the recent studies that this relationship has been weakening in recent years, possibly due to global warming.

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 found 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 northwest, across the northern part of the Indian subcontinent in an arc. The main range of the Himalayas (the Great Himalayas) includes, from Afghanistan, Pakistan, India, Nepal and Bhutan 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.

River systems

Some of the world's largest river systems are in the South Asia. The River Indus originates in China and flows to Pakistan. The Ganga-Brahmaputra river systems originate partly in Bhutan, China and Nepal and flow to Bangladesh and India. The Indus is one of the world's greatest river systems, measuring 3 180 km, from its source to the sea. The Ganga stretches for about 2 525 km and the Brahmaputra – the third great Himalayan river, stretches for about 2 900 km flowing through Tibet, India and Bangladesh. Many minor rivers that originate from the Himalayas and drain into Bangladesh, through Nepal and India. The Ganga, Brahmaputra and Meghna are the major rivers in Bangladesh. Some of the major rivers in Bhutan are Amochu, Wangchu, Sunkosh chu, Manas chu, Kurichu and Nyera Ama chu. There are 103 rivers draining, in a radial pattern from the Central Highland of Sri Lanka. Maldives does not have any rivers.



December and January's rains often trigger floods in Sri Lanka

Photograph: Jeremy Williams

Socio-economic and cultural patterns

South Asia displays 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 who have either, immigrated to the land or have come in contact with it. Under Mogul rule in India, for example, migrants from Afghanistan, Central Asia and Persia, introduced their culture, literature, architecture and military practices into the sub-continent, enriching the already high levels of native civilization. All countries in the region, in turn, share regional cultural 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. Vaastu Shastra and the Atharva Veda, in Hindu tradition; and Kurullu Paluwa, Bija and Wagamaruwa, in Sri Lanka, are some of the established ethno-scientific methods to maintain and improve the quality of life.

South Asia is an amalgamation of myriad, multicultural ethnic, religious or linguistic groups that have a common bond to their own heritage, culture, values and ways of life. Cultural liberty is the capability of people to live the way they choose to, with adequate opportunity to consider alternative options. In addition, socio-economic factors like hunger, poverty, joblessness and trauma have created inhuman conditions, and given rise to the need to break the shackles of extreme want, through extreme actions. Without a multicultural policy, in this region, that incorporates other aspects of development, the imagined problems of diversity can become self-fulfilling prophecies. Gross National Happiness (GNH), the unique development philosophy adopted by Bhutan, is an attempt to define quality of life in more holistic and psychological terms than the conventional Gross National Product. The four pillars of GNH are the promotion of equitable and sustainable socio-economic development, preservation and promotion of cultural values, conservation of the natural environment, and establishment of good governance. Of the countries in South Asia, two are predominantly Hindu, namely, India and Nepal; four are



GNH connects Bhutan's development goals with the pursuit of happiness

Photograph: istockphoto.com



The rich cultural heritage is demonstrated by the numerous festivals celebrated through the year

Photograph: Manish Shakya

predominantly Muslim, namely, Afghanistan, Bangladesh, the Maldives and Pakistan; two are predominantly Buddhist, namely, Bhutan (Mahayana Buddhism) and Sri Lanka (Theravada Buddhism). Bangladesh is racially and linguistically homogeneous. Bengali is the dominant language (99 per cent). In Bhutan, the majority (approximately 70 per cent) of the population are Mongoloids or Indo-Mongoloids. India's population is divided by race, language, religion, caste and tribe into numerous and partly overlapping ethnic groups. Racially the population is relatively homogeneous (Caucasoids), except for small racially different (Mongoloid) tribal groups. Language divides the Indian population into many large and small territorially concentrated minorities. Hindi (30 per cent) is designated the official language, though it is the dominant language, only in some northern Indian states.

The economic base

The South Asian region is a key economic zone, as 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 Maldives and possibly Sri Lanka, are all major debtor countries and unable to break free from the 'low-level equilibrium trap' - created by low rates of capital formation, that compounds the need to secure resources from other sources, to build up a capital base. Following the East

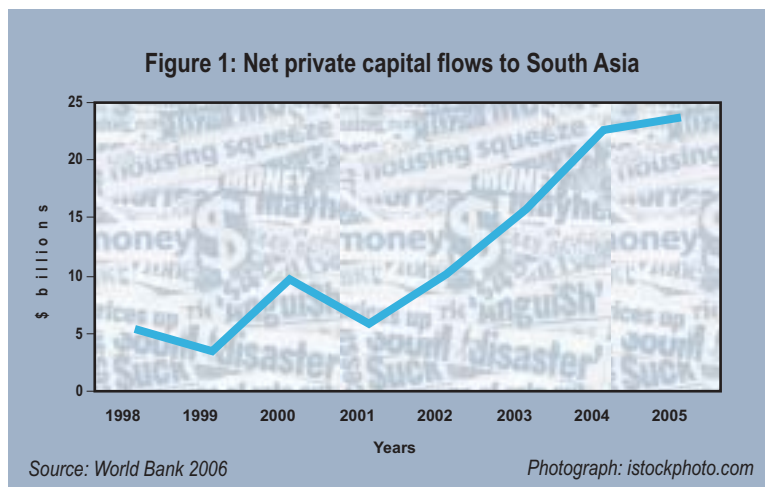


The consumer goods industry in South Asia is rapidly growing to cater to the large population

Photograph: Vivek Chugh

Asian meltdown, there has been a diversion of global funds towards this region (figure 1) and therefore, this 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, the world market is a much more complex and developing countries are increasingly being marginalized 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.

Over the last few years, South Asia has been one of the fastest growing regions in the world. Between 2000 and 2004, the region registered an annual GDP growth rate of 5.6 per cent, which was higher than the average annual growth rate of Southeast Asia (4.9 per cent) but slightly below East Asia's (the fastest growing region) 6.8 per cent. In 2005, GDP growth in South Asia is estimated to have accelerated to 6.8 per cent per annum, higher than Southeast Asia's 5.0 per cent and almost on par with East Asia's 6.9 per cent. Although such a high average GDP growth rate of South Asia was dominated by India, other South Asian countries also experienced relatively higher GDP growth, exceeding 5.0 per cent in 2004, except for Nepal: and the Maldives in 2005 (Table 1). The lower growth rates of Nepal was due to the civil conflict and in the case of Maldives was caused by the heavy damage from tsunami in 2005. South Asia's robust economic performance, supported by sustained growth in industry and service sectors, is expected to continue in 2006, with an average growth rate at 6.6 per cent. This projected GDP growth rate is higher than Southeast Asia's projected 5.4 per cent and comparable with East Asia's 6.9 per cent.



The improved overall economic performance of the region, to a large extent, reflects structural reform and liberalization policies being adopted by most South Asian countries, from the mid-eighties. Such reforms encouraged market forces and the private sector to play a more prominent role in driving the economies, compared with the state-led development model of the sixties and seventies. The region's economy also moved away from a high degree of dependence on primary products to a more

Table 1. Growth Rate of Gross Domestic Product (per cent)

Country	2000	2003	2004	2005*	2006*
South Asia	4.5	7.8	6.8	6.8	fi.6
Afghanistan	–	15.7	8.0	13.6	10.0
Bangladesh	5.9	5.3	6.3	5.4	5.5
Bhutan	5.5	6.5	6.8	8.0	8.0
India	4.4	8.5	6.9	6.9	6.8
Maldives	4.8	8.4	8.8	1.0	9.0
Nepal	6.0	2.9	3.9	2.0	3.0
Pakistan	3.9	4.8	6.4	6.4	6.5
Sri Lsnka	6.0	5.9	6.4	5.1	5.5

* *Asian Development Bank Estimates.*

– *Data not available.*

Source: *ADB 2005*

diversified economic mix, with an increased share of industry and services. Despite efforts to improve regional cooperation, the stark fact is that South Asia is still less integrated economically than most other regions of the world, such as Southeast and East Asia, Europe, and the Americas. However, prospects for advancing regional cooperation are now better than at any time in the last 50 years

Cooperation in the region

South Asian Association for Regional Cooperation (SAARC) was established in 1983, and its Charter formally adopted in 1985 by the Heads of State of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. With its headquarters in Kathmandu, SAARC provides a platform for the peoples of South Asia to work together "in a spirit of friendship, trust and understanding". SAARC focuses on economic cooperation, but also covers many aspects of regional cooperation, including the environment. The SAARC committee on environment was set up in 1992. In 1997, SAARC environment ministers agreed to an Environment Action Plan and a common SAARC position on climate change. In the more recent Islamabad Declaration of January 2004, the Heads of State agreed to "undertake and reinforce regional cooperation for the conservation of water resources and environment, pollution prevention, control of, as well as preparedness to deal with natural calamities. They also expressed strong support for the "early and effective implementation of the SAARC Environment Action Plan and the preparation of a SAARC state of environment report, as well as the commissioning of the work on drafting a Regional Environment Treaty. More recently, the SAARC Environment Ministers at there meeting in Dhaka in July 2008, adopted the Dhaka declaration on Climate Change and an action plan on Climate Change.

The threat to natural resource endowments in South Asia need not be re-emphasized. Countries in the sub-region also need to pursue measures that reduce production and trading costs through sharing of basic resources. Recognising the need for regional cooperation in sharing and management of natural resources, the South Asia Cooperative Environment Programme (SACEP) was established in 1982..

References

ADB (2005) *Asian Development Outlook, 2005 Update*. Asian Development Bank, Manila

ADB (2005) *Key Indicators 2005*. Asian Development Bank, Manila

Bhutan Environment Outlook 2008, NEC.

World Bank (2006). *Global Development Finance: The Development Potential of Surging Capital Flows*. The World Bank, Washington



Land



South Asian economies are mainly based on agriculture and therefore, land is an important resource. The region that occupies 4.8 per cent of the world's total land area, displays an extraordinary diversity of landforms due to climatic regimes, latitudes, altitudes and topography. Land, in South Asia, is under immense pressure as agriculture, urban land and wild areas all compete for the same resource. The demand for land has increased, along with the intensity of land use, and this combination culminates in environmental damage and the degradation of land quality.

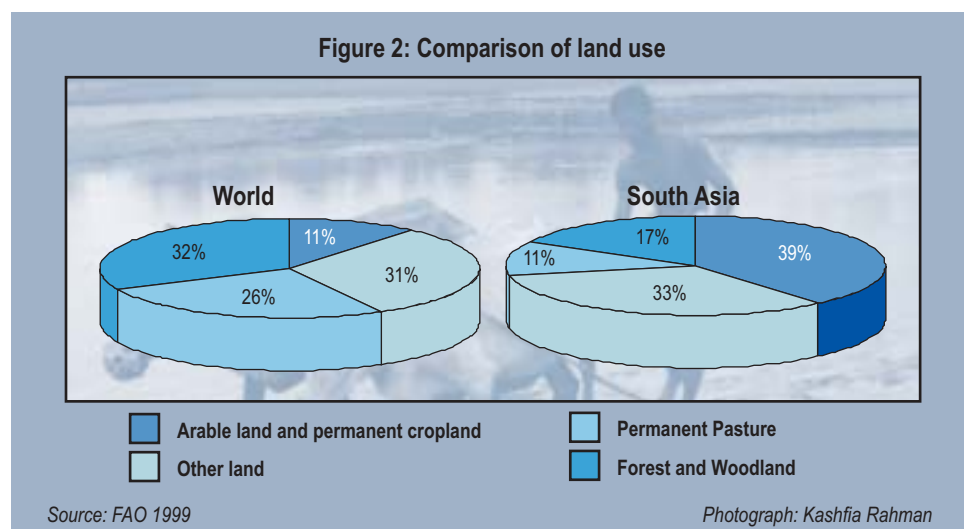
The three major physiographic regions identified are: the mountain belt of the Himalayas, comprising the Hindu Kush range that stretches along the entire northern border of the region, including parts of all countries except Maldives and Sri Lanka, the alluvial plains of the Indus and Ganges river systems of Bangladesh, India and Pakistan; and the uplands of the Deccan in India, together with the central hill massif of Sri Lanka.

Land use practices

Of the five sub-regions of Asia and the Pacific, South Asia has the largest area under crops and poorer sections of its population depend on agriculture for subsistence (Figure 2).

The number of people in South Asia is increasing at a rate of about 1.8 per cent per year and this increases the demand on food production to meet their requirements, without importing. However, a comparative increase in the amount of agricultural land is not seen and there is a slight decrease in some parts of South Asia.

Around 60 per cent of the South Asian labour force is still involved in agriculture, while in Nepal more than 90 per cent of the populations are involved in this sector and 37 per cent of the Sri Lankan population is dependent on agriculture. The sector contributes to about 25 per cent of the GDP in the region. Between 1960 and 2000, the share of agriculture in national GDPs, in the region, has decreased by 20 per cent, and yet the population dependent on agriculture has remained the same. This has led to unemployment, under-employment and migration to urban areas. The region's



agriculture is characterized by small landholdings in the alluvial lowlands, where too many people depend on too little land and production, is largely for subsistence. The high rates of tenancy and lack of new technologies compound the problem. Rice is the staple food crop and is usually grown under wet conditions. The four most important agricultural systems used in the region are given in Table 2.

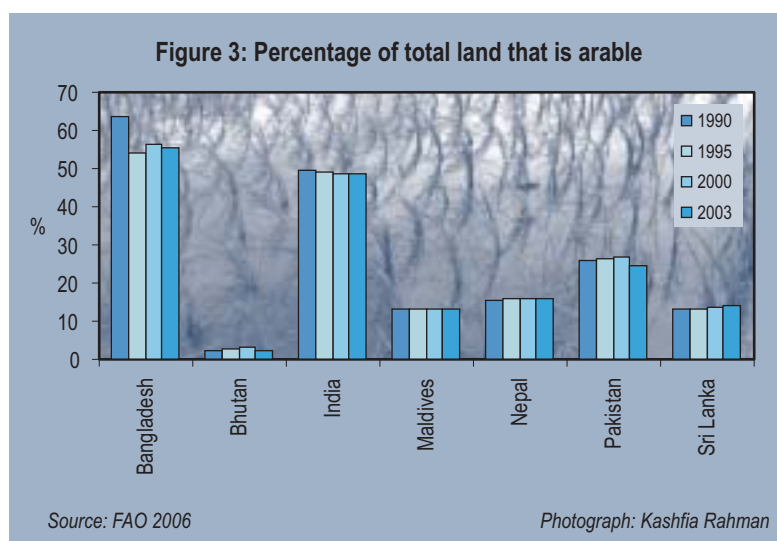
Table 2: Major Farming Systems in South Asia

Farming Systems	Land area (% of the region)	Agricultural Population (% of the region)	Principal Livelihoods
Rice	7	17	Wetland rice (both seasons), vegetables, legumes, off-farm activities
Rice-wheat	19	33	Integrated rice, wheat, vegetables, livestock including dairy, off-farm activities
Highland Mixed	12	7	Cereals, livestock, horticulture, seasonal migration
Rainfed Mixed	29	30	Cereals, legumes, fodder crops, livestock, off farming activities

Source: FAO; World Bank 2001

Diminishing arable land

Figure 3 shows the change in the percentage of arable land from 1900 to 2003. The amount of arable land in India reduced from 163 million hectares to 161 million hectares in this period. The arable agricultural land mass in Afghanistan is about eight million hectares, which is 12 per cent of the total land mass and is one of the important sources of livelihood. However, only six per cent of the usable agricultural land is under cultivation (Afghan Government Statistics, 1994). Percentage of total land area that is



Northeast Afghanistan has high mountains with snow, lower mountains without trees and some agriculture land

Photograph: istockphoto.com

arable for Bhutan is 7.8 as per the Compendium of RNR Statistics (2008). Arable land production is largely land per capita, which is decreasing in South Asia, though many economies in the region are dependent on agriculture. Urbanization, population growth and industrialization are the main causes for the decrease in arable land availability. Land degradation also has negatively impacted the quality and quantity of arable land and the reduction in arable land per capita has a negative impact on agricultural production, posing a threat to food security of countries in the region.

The percentage of land under agriculture, in South Asia, is unclear, however it appears to be increasing in some areas. While the amount of land may not show an obvious change, the way in which agricultural land is being used is changing. There was an increase in irrigation - from 28 per cent to 37 per cent - of total agricultural land, in South Asia,

between 1990 and 2003. This increase in irrigation can result in water logging and salinization. It will also affect erosion by washing away the topsoil and micro-nutrients. Figure 4 shows the percentage of irrigated land in South Asian countries.

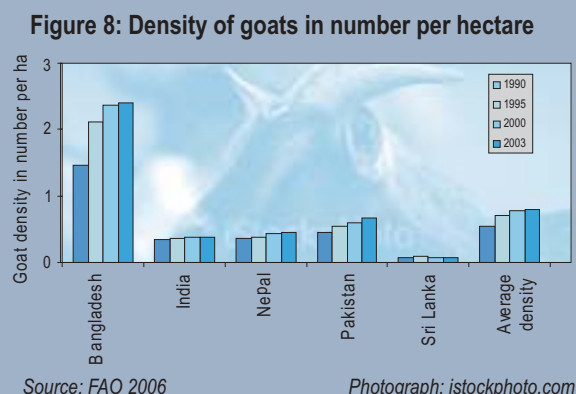
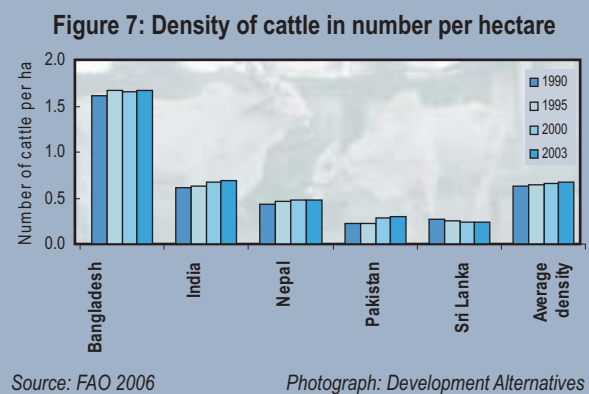
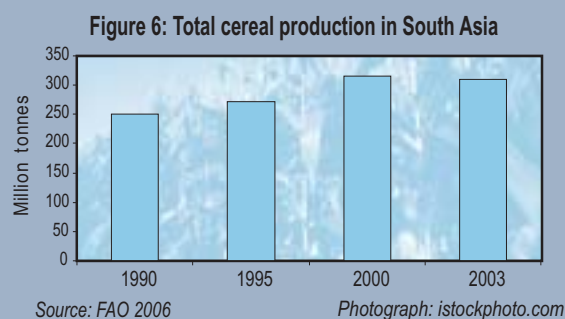
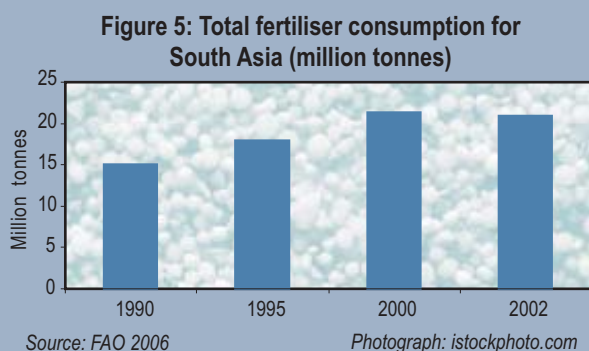
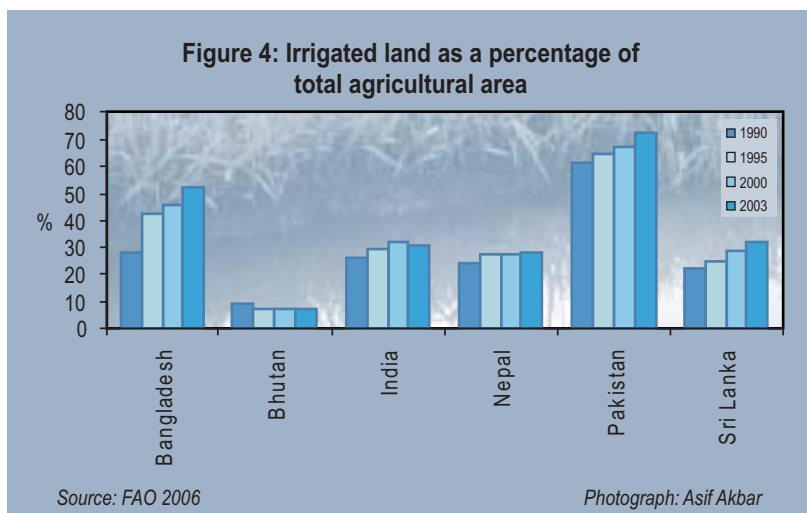
Enhanced agricultural intensity

The amount of fertiliser use in agriculture has increased from 15.09 to 20.88 million tonnes, between 1990 and 2002. The amount of cereal production also increased from 25.1 million tonnes in 1990 to 31.0 million tonnes in 2003

which demonstrates the increase in the intensity of arable agriculture production. This places pressure on the lands ability to cope, as more water is used, more physical disturbance is created and more chemicals are applied. An increased intensity of agriculture is also seen in the some yields, such as barley and paddy. Figure 5 shows the increase in fertiliser use and figure 6 the cereal production.

Degradation due to livestock

Non-arable agriculture has also intensified and the numbers of cattle, goats, chicken and ducks have all increased, along with have their stocking density. The absolute number has almost doubled from about 1 billion animals to about 1.9 billion animals, between 1990 and 2003. The density of cattle has increased from 0.63 cattle/ha in 1990 to 0.67 cattle/ha, in 2003, and the density of goats has increased from 0.54 goats/ha in 1990 to 0.79 goats/ha in 2003. Figure 7 shows the density for cattle and figure 8 for goats.



Livestock densities have a large impact on land quality as they affect a range of factors, such as physical disturbance and use of vegetation. Animals are often sent out to pasture in areas, which can be marginal or depleted, causing the loss of remaining vegetation and increasing the exposure of the land to erosion.

Increasing urban areas

The growth of urban areas has seen a marked increase in the last ten years and is predicted to continue for the next ten. The population density of South Asia, in 2006, was 4.4 people/ha, ranging between 10.1 people/ha in Bangladesh and 0.2 people/ha in Bhutan (PRB 2006). The ratio of urban to rural population in South Asia has increased from 20 per cent urban in 1990 to 25 per cent in 2005. The decline in rural population over the years is shown in figure 9. The population of South Asia is growing at a rate of 1.8 per cent (PRB 2006), but its urban population is growing at a rate of 3.7 per cent (WRI 2000-2005). The increase in urban population will have a notable impact on land use. It is often argued that as agricultural areas are being converted into urban areas, farmers are forced to access more marginal land that was left fallow, earlier. This marginal land may not be very productive and its change to agriculture use may affect other environmental services that were previously provided. For example, a fallow area of land can positively affect the micro-nutrients and topsoil retention.

Salvaging forests

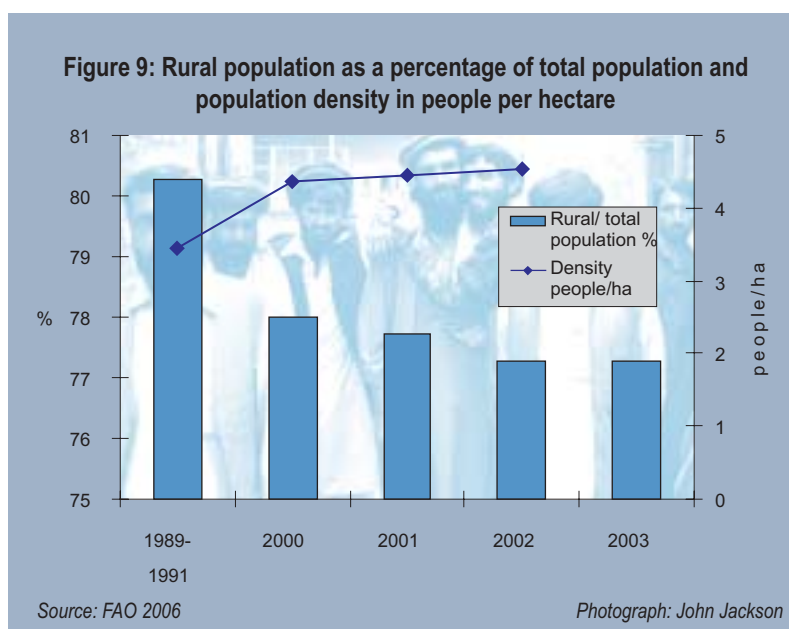
South Asia is home to diverse ecosystems and different kinds of forests, ranging from the Himalayan forests to mangrove habitats. Increasing populations, clearing of forests for agriculture and human settlements have put pressure on the forest cover in South Asia. The forest cover in Bhutan and Maldives has remained constant, while it has increased in Bangladesh, India and Pakistan, over the decade. This is perhaps, because of the strong forestation and reforestation programmes of these governments. The maximum forest cover loss was reported in Nepal, while Bhutan is the only country in the region with more than 60 per cent of its land under forest

cover. Two thirds of Bhutan's land is under forest cover and the country has been making determined efforts to preserve its natural environment, through the promulgation and implementation of strict environment conservation laws and the success of the programme is reflected by the dense forest cover of the country. Between 1990 and 2005, the total forest cover has increased from 77.6 million hectares to 79.2 million hectares (FAO 2005). In Nepal, the forest cover has decreased from 4.8 to 3.6 million hectares between 1990 and 2005, while in India the green cover has increased from 63.9 to 67.7 million hectares (FAO 2005).

The type of forestry has also changed. The amount of plantation forest has increased and this can change a forest's influence on the environment. The amount of plantation forest in South Asia has increased from 2.7 million hectares in 1990 to 4 million hectares in 2005, a percentage increase from 10 to 13 per cent of the total forest cover (Figure 10).

Deforestation pressures

Deforestation is a threat to land quality. The average decrease in forests was 0.7 per cent between 1990 and 2000 and 0.8 per cent between 2000 and 2005 (FAO 2005). This loss occurred in countries such as Bangladesh, Nepal, Pakistan



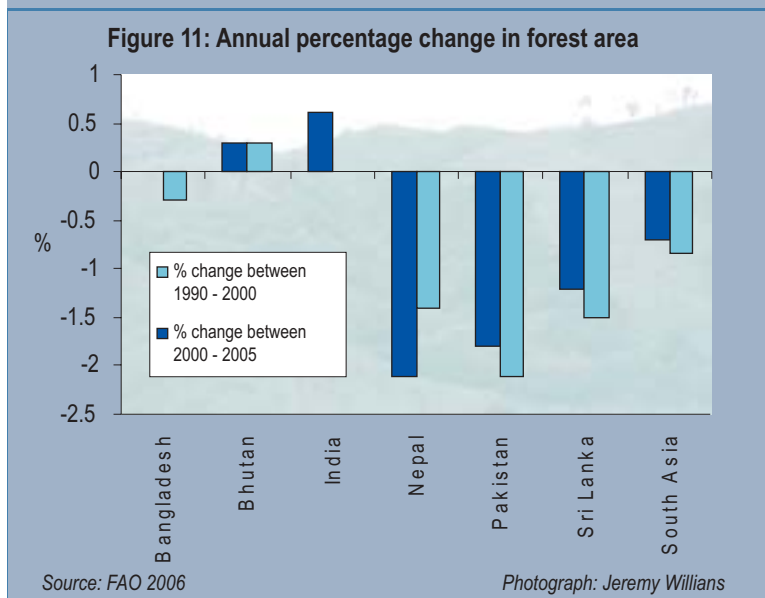
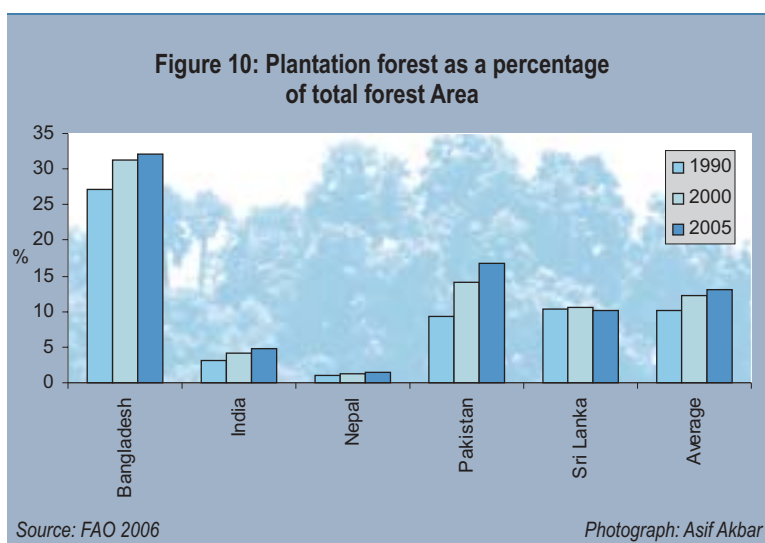
and Sri Lanka, while there was an increase in Bhutan, India and Maldives. Deforestation is a serious and widespread problem in Afghanistan. The cause of deforestation includes clearing of forest lands for shifting cultivation; permanent agriculture or settlements; fuel requirement for domestic combustion; timber for construction and furniture; and development of roads. Figure 11 depicts the change in the total area of forest cover between 1990 to 2000 and 2000 to 2005.

Land degradation

Land degradation processes include erosion; compaction and hard setting; acidification; declining soil organic matter and soil fertility depletion; biological degradation; and soil pollution. Land degradation is a major problem in all South Asian countries. Degradation caused by water is perhaps the greatest challenge facing South Asia, as many areas have periods of high rainfall and steep mountainous regions. Modern methods of agriculture have contributed to land degradation, with practices such as overuse of fertilisers and pesticides, excessive irrigation of saline lands and shifting agriculture. The management of steep land is important to prevent the loss of topsoil and micro-nutrients and all the resulting off site effects. Forestry and vegetation are vital for retaining the soil and preventing land slides on steeper land.

Recent estimates indicate that in South Asia, 42 per cent of the land is affected by one or other factors that cause land degradation. Half the region's dry lands face the threat of desertification, with as much as 63 million hectares of rain-fed cropland and 16 million hectares of irrigated land having been lost due to it, especially in India and Pakistan; and, the land degradation was higher in India. Other countries have also been badly affected. It is estimated that nearly one-third of the land in Sri Lanka has been subjected to soil erosion. One-fourth of Pakistan's total land area is facing serious threats of water and wind erosion. In parts of Bangladesh and northern India, soils have become acidified and salinized. The steep terrain of Nepal is susceptible to soil erosion and landslides. As per Global Assessment of Soil Degradation (GLASOD) estimates, six per cent of Afghanistan's land is very severely affected and ten per cent is severely affected due to anthropogenic activities. An area of about 75 per cent is affected by loss of top soil due to both water and wind, the former being more serious. Extensive erosion of riverbanks, leading to siltation and the loss of valuable farmland, is also increasing due to the loss of tree roots that hold the soil in place.

A UNDP/UNEP/FAO study has estimated that the land degradation cost of these countries in the region amounts to more than US\$10 billion per year, which is quite a high value for the Asia-Pacific region. This amount is equivalent to seven per cent of the region's combined agricultural GDP. Bhutan, due to its low population density, has not yet



suffered severe land degradation, but deforestation - often a precedent to degradation - is a concern and ten per cent of the agricultural land has been affected by soil erosion. The principal causes of land degradation are erosion by water, followed by the wind, along with biophysical and chemical degradation. Humid zones in Bangladesh, Nepal, India and Sri Lanka are mostly affected by water erosion. The most devastating form of water-borne land degradation in Bangladesh is riverbank erosion. Water logging and salinization affects between two to three million hectares in India and Pakistan, respectively. In Pakistan, salt buildup in the soil is known to reduce crop yields by 30 per cent. Chemical soil degradation in the region is mainly caused by agricultural mismanagement. Land affected by wind and water erosion is shown in figure 12 and 13.

Dry lands

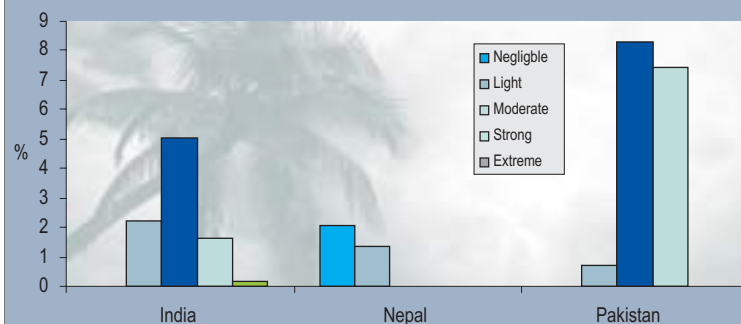
Areas of South Asia with a high proportion of dry lands will need to address the problems of desertification and wind erosion. The amount of dry lands in South Asia is shown in Figure 14. When soil is dry and denuded of vegetation, the top soil becomes vulnerable to loss and movement due to the wind. In Afghanistan, the phenomenon of land desertification has been observed in several zones of the country and has emerged as an important component of land degradation. It is estimated that 80.7 per cent of the country's area is vulnerable to desertification, of which 67.4 per cent is classified as very highly vulnerable, 6.7 per cent as high, 6.1 per cent as moderate and 0.5 per cent having low vulnerability (Eswaran et. al. 2001).

Livestock density in dry lands is a crucial factor in terms of spreading desertification. The Government of India estimated that over 434 million livestock animals were in the hot arid regions in 2001 (UNCCD 2001). This is approximately 40 per cent of the entire Indian livestock.

Salinity

In desert and dry lands, salinity is a problem due to the high rate of evaporation that causes water to be drawn up from saline aquifers. Salinization occurs in areas with wetter climates. Bangladesh, India and Pakistan are all affected by considerable salinization, as can be seen in Table 3. In Afghanistan, about five per cent of country's land mass is impacted by salinization and it is predominant in the irrigated fields of Helmand Valley (CEPA, 2005).

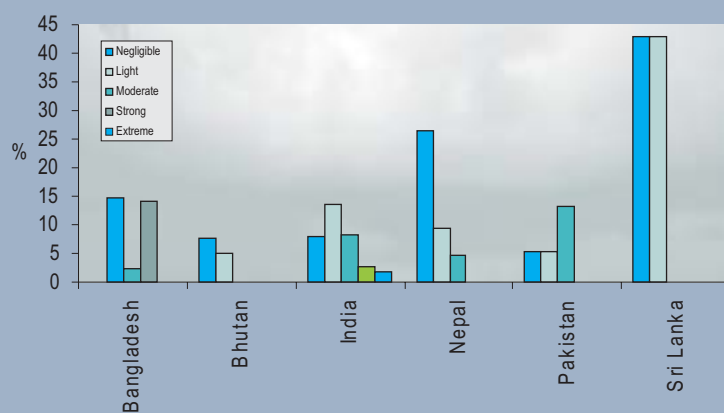
Figure 12: Percentage of land affected by all types of wind erosion
(loss of topsoil, terrain deformation & off-site effects)



Source: Bangladesh Bureau of Statistics 2005

Photograph: istockphoto.com

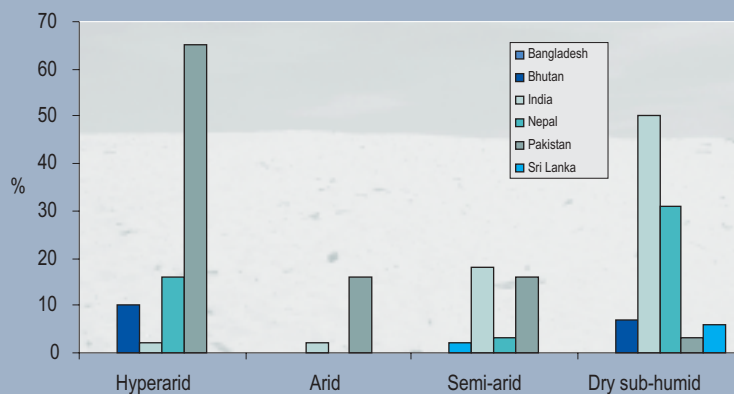
Figure 13: Percentage of land affected by all types of water erosion
(loss of topsoil, terrain deformation & off-site effects)



Source: ISRIC 1997

Photograph: istockphoto.com

Figure 14: Percentage of desert and dryland by country in 2003



Source: Bangladesh Bureau of Statistics 2005

Photograph: istockphoto.com

Table 3: Water Logging and Salinization in Bangladesh, India and Pakistan

	Bangladesh	India	Pakistan
Water logging (million ha)	0.7	8.52	5.2
Salinization (million ha)	3.05	7.61	5.3

Source: Bangladesh 2001/1999, India 2001, Pakistan 2003/2005

Salinity in coastal areas is caused by saltwater intrusion resulted by over-extraction of groundwater, upstream extraction or damming of rivers and by the post tsunami effects or other natural processes.

While problems of the environment do not recognize international frontiers, efforts to combat land degradation must be based largely upon national institutions. This applies not only to work undertaken at the national level, for example soil conservation programmes, but to regional and international efforts, which must be largely applied through national institutions.

Engagement measures

To attenuate the problem of land degradation the following measures can be taken at the national level:

1. Development and implementation of national land use policies
2. The widespread rural infrastructure development should be accelerated to mitigate increased urban migration
3. Reforestation programmes and declaration of protected areas
4. Integrated watershed management
5. Integrated rural development
6. Integrated coastal area and river basin management
7. Building awareness and local capacity
8. Providing incentives on the basis of long term leases as opposed to short term leases to encourage soil conservation measures
9. Investments in research and development to developed and disseminate alternative techniques of soil conservation such as Sloping Agriculture Land Technology (SALT)
10. Practice of providing land in lieu of employment opportunities should be discouraged
11. Introduction of sustainable technologies
 - a. Sloping agriculture techniques
 - b. Rainwater harvesting

As South Asia is among the most populated and impoverished regions in the world, the Regional Action Programme should focus on making a contribution towards improvement in livelihood security. One of the main problems facing



Fiscal and sectoral policies need to take explicit account of the unintentional impacts on land degradation

Photograph: Development Alternatives

land resource management is the high dependency of populations on agriculture for their livelihood. Steps should be taken to enhance land resource management to provide the food security to increasing populations through advancement of agricultural research, technology and extension services.

The importance of giving priority to accelerate the widespread neglect of rural infrastructure development to mitigate rural-urban migration must be stressed. Transboundary issues, such as water resources management and disaster mitigation, are important and water resources management must be integrated into the land management. Development of alternative energy sources will reduce pressure on forest cover and it is important that communities participate at grassroots levels.

Regional cooperation is vital for developing improved tools and techniques on assessment, data management and setting standards for monitoring. This will include: technical cooperation for developing desertification control action plans and drought and disaster mitigation strategies; information sharing on good land-management practices; joint research programmes to improve agricultural quality; increasing trade cooperation through bilateral and multilateral agreements.

References

- Bangladesh Bureau of Statistics (2005). *Compendium of Environmental Statistics of Bangladesh 2005*.
- Compendium of RNR Statistics (2008). Ministry of Agriculture, Govt. of Bhutan
- Dev M. S. (2007). *Undernourishment in Asia. Taking Action for the World's Poor and Hungry People*. Beijing, China October 17–19, 2007. International Food Policy Research Institute.
- Eswaran, H.; Lal, R. and Reich, P.F. (2001). Land Degradation: an Overview. In Bridges, E.M.; Hannam, I.D.; Oldeman, L.R.; Pening de Vries, F.W.T.; Scherr, S.J. and Sompatpanit, S. ed., *Responses to Land Degradation*. Proceedings – 2nd International Conference on Land Degradation and Desertification, Khon Kaen, Thailand. Oxford Press, New Delhi, India.
- FAO (1994). *Land Degradation in South Asia: Its Severity, Causes and Effects upon the People*. Food and Agriculture Organization of the United Nations. <http://www.fao.org/docrep/V4360E/V4360E00.htm>
- FAO (2005). *FAO Food Outlook 2005*. Food and Agriculture Organization of the United Nations. <http://www.fao.org/docrep/009/J7927e/J7927e15.htm>
- FAO (2005). *Global Forest Resources Assessment 2005: Progress towards Sustainable Forest Management*. FAO Forestry Paper 147. Food and Agriculture Organization of the United Nations (FAO). <http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=101&langId=1>
- FAO (2006). *FAOSTAT Online Statistical Service*. Food and Agriculture Organization of the United Nations (FAO). <http://faostat.fao.org>.
- FAO; World Bank (2001). *Farming Systems and Poverty: Improving Farmers' Livelihoods In A Changing World*. Food and Agriculture Organization of the United Nations and The World Bank, Rome and Washington DC
- IRRI (2004). International Rice Research Institute. <http://www.irri.org/science/ricestat/pdfs/WRS2005-Table03.pdf>
- ISRIC (1997) - *The Assessment of the Status of Human-induced Soil Degradation in South and Southeast Asia*. International Soil Reference and Information Centre (ISRIC) 1997. <http://www.isric.org/isric/webdocs/Docs/ASSODEndReport.pdf>
- PRB (2006). Population Reference Bureau. <http://www.prb.org/pdf06/06WorldDataSheet.pdf>
- SACEP (u.d.). *Sustainable Land Management: South Asia Perspectives*. South Asia Cooperative Environment Programme.
- UNCCD (2001). *India National Action Plan*. UNCCD Report. United Nations Convention to Combat Desertification. <http://www.unccd.int/>
- UN ESA (2004). Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.
- UN (2005). *World Population Prospects: The 2004 Revision*. Department of Economic and Social Affairs of the United Nations Secretariat.



High levels of urban air pollution have attracted growing attention from the government, civil society, and industry in South Asian countries. Poor air quality threatens human health and causes other forms of environmental damage. With continuing migration from rural to urban areas, air pollution will affect an increasing percentage of the urban population in the coming years. Urban growth and industrialisation in South Asia have caused air pollution to become a problem of real concern. Exposure to high concentrations of harmful chemicals and substances in the air can result in illness and loss of life. This is true of urban areas, where transport is the largest source of pollution; others include energy generation and industry.

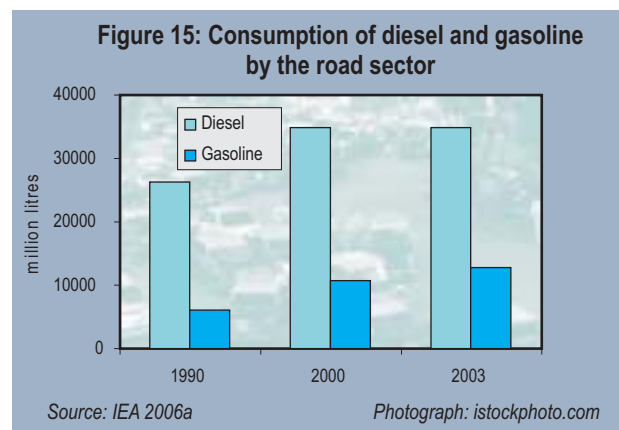
Fallouts of urbanization

Air pollution levels in the most populated cities are amongst the highest in the world, seriously impacting human health and affecting aquatic and terrestrial ecosystems. Transport – especially two-wheelers and diesel driven heavy trucks – is a significant source of urban air pollution. Calcutta, Delhi, Dhaka, Karachi and Mumbai are examples of megacities that produce unacceptably high emissions of health-endangering gaseous and particulate matter. The number of vehicles in the cities of South Asia has seen a rapid increase in the last ten years. In Delhi alone, the vehicular population has increased around tenfold in 20 years (from 0.2 M to 2.6 M) and accounts for more than 60 per cent of the particulate pollution. The increase in the consumption of fuels by the transport sector is shown in figure 15.

Fuelling indoor air pollution

Indoor air pollution is often a more severe health hazard than outdoor air pollution. Most rural inhabitants in the region use twigs, grass, dried animal dung, crop residue, wood, charcoal and kerosene oil as household fuels. Coupled with inadequate ventilation, this results in highly contaminated indoor air. Given the high levels of harmful emissions and the number of people using traditional cooking fuels – Asia produces nearly half of the world's wood fuel – the scale of exposure is large (FAO 2001).

Health effects include acute respiratory infection in children, chronic obstructive lung disease, adverse pregnancy outcomes and lung cancer in women. Acute respiratory diseases are prevalent in the rural and/or hilly areas of Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka where indoor air pollution is high. About 40 per cent of the global infantile mortality caused by pneumonia occurs in Bangladesh, India and Nepal; and many of these deaths are caused by pollutants from burning traditional fuels (ADB 2001).



In India, household solid fuel use is estimated to cause about 500 000 premature deaths a year in women and children under five. There are indications that tuberculosis and blindness may be associated with indoor air pollution. Indoor air pollution is blamed for five to six per cent of the national burden of diseases in women and children in India (Holdren and Smith 2000). The key areas for intervention are: use of cleaner fuels such as low-propane gas and kerosene; development of high-grade biomass fuels; improvements in stove design and better dissemination of stoves; improvements in housing; and improvements in environmental awareness and education. To address the problem of indoor air pollution in India, around three million biogas plants and more than 22 million improved cooking stoves have been installed in rural and remote areas of the country, resulting in a saving of the equivalent of 21 million tonnes of firewood per annum.



Dry dung pellets are used as fuel in rural India where kerosene and cooking gas is not available

Photograph: Vasant Dave

Hazardous particles

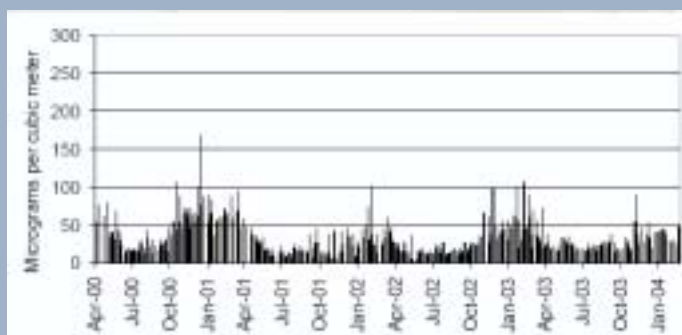
The pollutant of special concern, in South Asia, is small particulate matter due to its high ambient concentrations and documented impact on morbidity and premature mortality. The level of particulate matter, in a number of cities in South Asia, with an aerodynamic diameter of less than 10 microns (PM10) exceeds internationally accepted standards by several times. Two major contributors to high ambient concentrations of PM10 in the transport sector are two-stroke engine gasoline vehicles and heavy duty diesel vehicles. Large cities in India and Pakistan appear to have very high concentrations of small particles. Apart from these countries, Dhaka in Bangladesh (and possibly other large cities, where data is not available) and Kathmandu in Nepal suffer from serious particulate air pollution, the latter in part because of its topography (being located in a valley which traps polluted air). The largest city in Sri Lanka, Colombo, has recorded lower levels of air pollution than other South Asian mega cities, although particulate levels are still moderately elevated. Outdoor pollution is an emerging concern in major urban centers in Bhutan, especially during winter, while it is not a problem in the Maldives.

Recently, several large cities have begun monitoring PM10 and PM 2.5. Consistent with high ambient Total Suspended Particulates (TSP) levels, the recorded levels of PM10 and PM 2.5 have been found to be elevated. Available data from Bangladesh, India and Sri Lanka shows PM2.5 data in Colombo, Dhaka, Delhi, Kolkata and Mumbai in figures 16, 17 and 18.

Suspended particulates

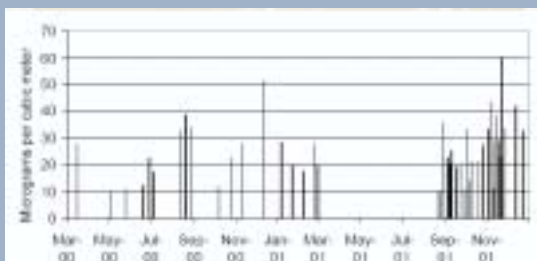
Particulate matter is the most prevalent cause for concern in terms of urban air pollution. The health dangers associated with prolonged

Figure 16: 24-Hour average PM2.5 data at semi-residential area, Dhaka, Bangladesh



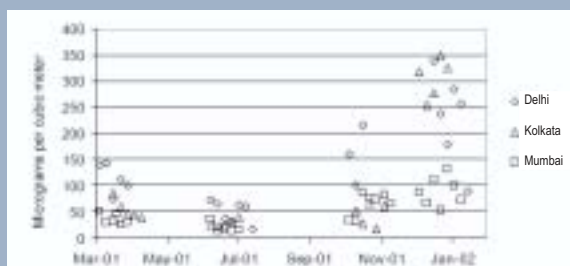
Source: IBRD, World Bank 2004

Figure 17: 24-Hour average PM2.5 data at Fort Railway Station, Colombo, Sri Lanka



Source: IBRD, World Bank 2004

Fig 18 : 24-Hour average PM2.5 data in Delhi, Kolkata, and Mumbai, India



exposure to high levels of particulate matter include an increased occurrence of acute respiratory syndrome, chronic obstructive lung disease, worsening of asthma, cardiovascular diseases and lung cancer (World Bank 2003).

Measurements of particulate matter are made across major cities in South Asia; however, comparative data sets over periods of time are hard to come by. Measurement is also complicated by the difference in levels at different locations, at different times of the day, at different times of the year, and with varying measurement periods and processes. Figure 19 shows the average values of measurements made in major cities at different times.

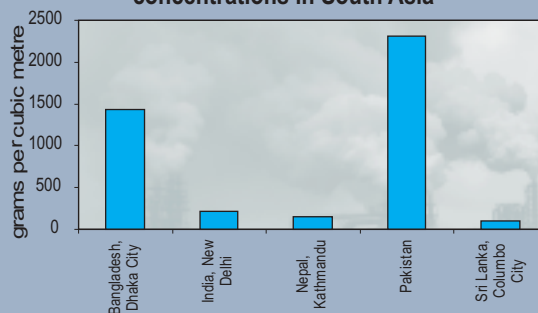
Other chemicals that cause pollution in urban environments are oxides of nitrogen (NO_x), sulphur dioxide (SO_2), tropospheric ozone (O_3), volatile organic compounds (VOCs) and lead. Atmospheric lead has seen a large decrease in South Asia due to the adoption of lead-free fuels. Particulate matter, SO_2 and NO_x , are the most important pollutants in terms of the quantities in which they are found. Figure 20, 21 and 22 depict how the atmospheric concentration of these three chemicals has changed over time.

The availability of data on atmospheric pollutants is a problem in South Asia. Comparisons can only be made between measurements at different intervals and under similar conditions. A standard monitoring system across the sub-region would greatly enhance the understanding of the situation.

Vehicular exhaust

Vehicular pollution is looked upon as a serious cause of urban pollution. Other causes also include the burning of

Figure 19: Suspended particulate matter concentrations in South Asia



Source: UNESCAP 2003; CEA 2006

Photograph: Marcin Rybarczyk

Box 1: Good Practices in Partnerships: Air Resource Management Centre in Sri Lanka

Deterioration of urban air quality is becoming a critical issue in the present context. A solution for this was complicated since the issue had to be addressed by many sectoral agencies. Therefore, the AirMAC was established in partnership with all responsible agencies. Major implementation bodies have cells within the AirMAC and all other partners are in the management committee. The AirMAC is owned by all stakeholders of air resource management. Since partners work together under the same roof, there is virtually no co-ordination problem. With this partnership initiative, Airmac was able to successfully develop and initiate implementation of mobile emission standards, vehicle importation standards and fuel quality standards of the country.



Urban air pollution is rapidly increasing
Photograph: Marcin Rybarczyk

Source: AirMAC 2005

Figure 20: Total suspended particle matter concentration in major cities

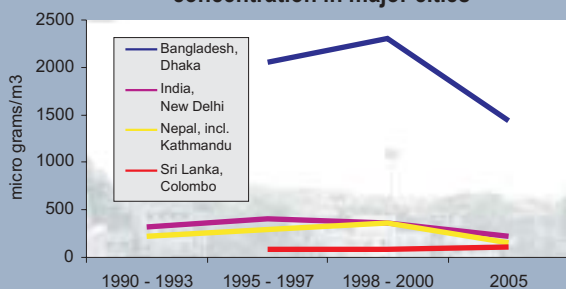


Figure 21: Sulphur dioxide concentration in major cities

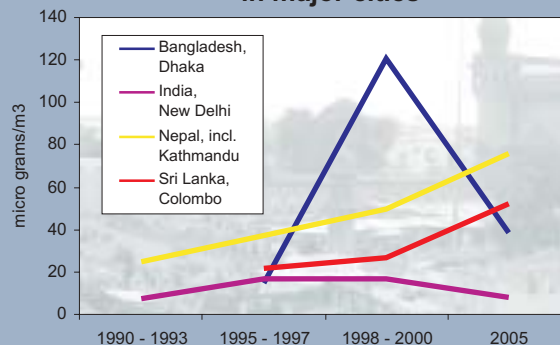
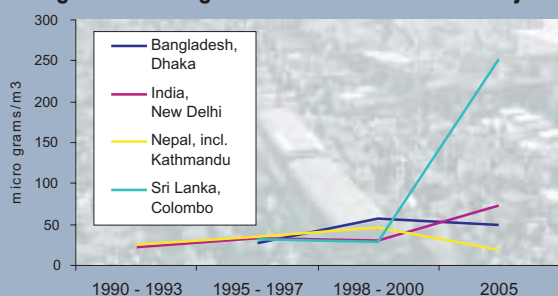


Figure 22: Nitrogen oxide concentration in major cities



Source: UNEP 2004, Bangladesh 2005, CPCB 2005, Government of Nepal 2005, UNESCAP 2003, CEA 2006



Traffic on a street in Hyderabad, India

Photograph: Asif Akbar

fossil fuels for energy point and industry, as well as other industrial point sources. Sources from industry will increase as manufacturing and other industries expand in the region.

Exposure to air pollutants can be severe, in terms of their effects on health. In Bangladesh around 15 000 people die from air-pollution related illnesses each year and in Nepal, incidences of chronic obstructive pulmonary disease increased by a factor of four in the last ten years. (ADB 2003) These health impacts can also be quantified in economic terms. This can be measured as loss of work due to sickness or in terms of the price of medical treatment. A study in India estimated that a one per cent increase in particulate matter results in a 0.5 per cent increase in the number of work days lost and in a 0.4 per cent increase in reduced activity days (SANDEE 2006). A study on the economic costs in India revealed that the total health costs amounted to \$1.3 billion per annum (ADB 2003)

Air pollution is not only a concern for individual countries and national targets. The INDOEX study shows that the Atmospheric Brown Cloud (ABC), a large area of atmospheric haze that covers large parts of in South Asia, impacts many countries in a region. Haze is a common phenomenon in the region in wintertime, even in high altitude areas.

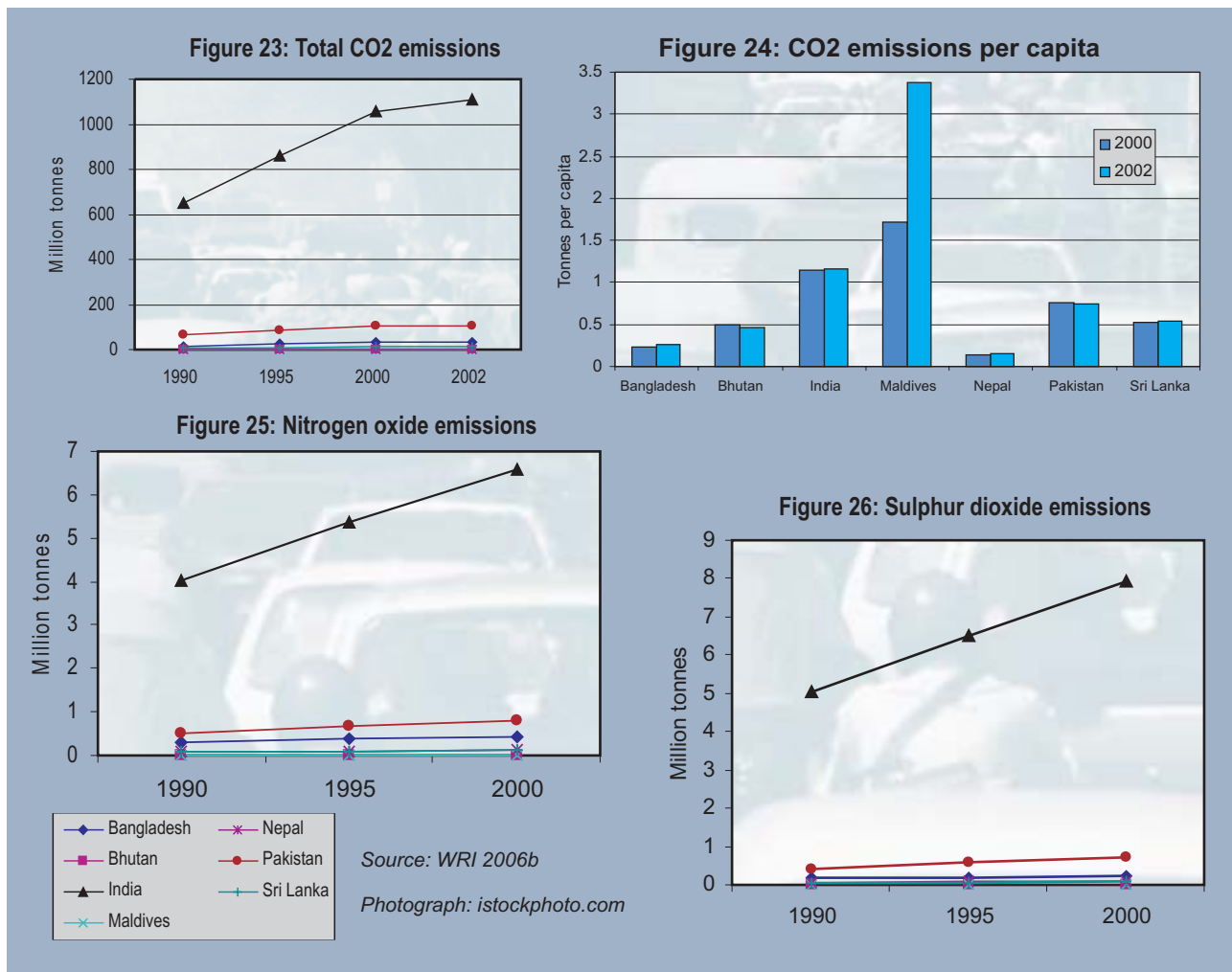
Greenhouse gases

Global warming is potentially the most serious environmental threat facing the planet today. If climate change predictions are realised then it will result in a catastrophic impact upon the survival and prosperity of

Box 2: Compressed Natural Gas (CNG) as Fuel for Transport in Pakistan

The commercial use of CNG in petrol vehicles has been successfully implemented in Pakistan due to government support. So far, more than 6 000 provisional licenses for establishing CNG refueling stations have been issued by the Oil and Gas Regulatory Authority (OGRA) and extensive investments have been made and more are proposed. The CNG industry has created an estimated 85 000 new jobs. A high demand for CNG fuel still exists countrywide with substantial foreign exchange. At present, 2 046 CNG Stations are operational with over 1.7 million vehicles are running on CNG.

Source: Government of Pakistan 2007



large numbers of people. South Asia's high level of economic and industrial growth means that the amount of Green House Gases (GHGs) that it produces is growing and could overtake the emissions of the most developed nations in the future.

Box 3: Atmospheric Brown Cloud

An international study by more than 200 scientists on the project Indian Ocean Experiment (INDOEX) in the spring of 1999, revealed thick layers of brownish clouds of air pollution, over an area of 10 million Sq. km referred to as Atmospheric Brown Clouds, hovering over a large area from the Himalayas to the Indian Ocean (Ramanathan et al., 2002, Ramanathan and Ramana, 2003). ABCs, which consists of light-scattering and light-absorbing particles (aerosols) and precursor gaseous pollutants, are mostly the result of emissions from various anthropogenic and natural sources such as biomass burning and fossil fuel combustion, and subsequent long-range transport that leads to formation of widespread layers of brownish haze. ABC is a transboundary, transcontinental and trans-oceanic phenomenon. It spreads over a large region and can travel across an entire continent or ocean basin within five to seven days (Ramanathan, 2003, Kaufman et al., 2002, Rosenfeld, 2001). ABCs form over most of South Asia and persist over 6-month long dry season (November - April) with minimal rainfall. The impacts of the ABC on precipitation patterns such as monsoon rainfall, water budget, agriculture, in conjunction with its impacts on human health, provide a strong rationale for reducing air pollution. Based on the scientific review of the initial assessment, UNEP has facilitated establishment of about a dozen aerosol and precipitation monitoring observatories across Asia and the Pacific, and as well as establishment of international scientific teams that are currently assessing the impacts of ABC on health, agriculture and water budgets in Asia.

Source: UNEP 2007

The total amount of CO₂ emitted by South Asia has almost doubled from 735 million tonnes in 1990 to 1264 million tonnes in 2002. Figures 23 - 26 show the trends in CO₂, SO₂ and NO_x. CO₂ emissions per capita have increased in all the countries of South Asia. This can be attributed to increasing demands of energy and combustion of fossil fuels, especially by thermal power plants. Power generation in the sub-region is largely dependent on coal. Fly ash from these power plants increases the particulate matter in the air.



An example of haze seen during an aircraft flight in Nepal at a location close to Mount Everest

Photograph: NTNC, Pradeep Sakya

Industrial pollution

Atmospheric pollutants such as NO_x and SO₂ also lead to acid rain, which has adverse ecological consequences.

Industrial emissions also contribute to air pollution. Industries in South Asia have traditionally paid scant attention to pollution control. Thus, wastes are almost completely emitted to the atmosphere.

An integrated air quality plan that encompasses various factors such as proper fuel policy, transport policy and traffic management needs to be put in place in South Asian countries to effectively address the problem of deteriorating air quality. Also, stringent checks need to be enforced on industrial pollution. Air quality standards should be strictly adhered to and pollution control devices used for the purpose.

Transboundary air pollution

The "Malé Declaration" on control and prevention of trans-boundary air pollution and its likely trans-boundary effects for South Asia is a good example of tackling trans-boundary air pollution through regional cooperation. This was a result of an initiative by UNEP RRC.AP together with the Stockholm Environment Institute to draw attention to the issue of air pollution and its transboundary effects in South Asia. The Draft Declaration was discussed and adopted by Ministers of the Environment of South Asian countries in April 1998. The Male' Declaration's objective is to aid the process of providing a clean environment through clean air. The Declaration calls for regional cooperation to address the increasing threat of transboundary air pollution and its possible impacts. During Phase I, a network was established, baseline studies were completed and action plans drawn up. Consequently, a capacity building programme was initiated in Phase II which included strengthening the monitoring network and training. National and regional level stakeholders consultation were also held during this phase. Phase III is now being implemented. This phase will use information and knowledge concerning air pollution problem in South Asian countries as a basis for the further development of the policy cycle in the region.

References

ADB (2003). *Technical Assistance to the South Asian Sub-regional Economic Cooperation Countries for Regional Air Quality Management*, Asia Development Bank. http://www.adb.org/Documents/TARs/REG/tar_oth_37014.pdf

AirMAC (2005). Air Resource Management Center. <http://www.airmacsl.org/about.html#about>

Bangladesh Bureau of Statistics (2005). *Compendium of Environmental Statistics of Bangladesh 2005*.

Central Bureau of Statistics (2005). *Environmental Statistics of Nepal 2005*. His Majesty's Government National Planning Commission Secretariat, Kathmandu, Nepal.

CEA (2006). Central Environmental Authority, Sri Lanka. <http://www.cea.lk/airqlty.pdf>

CPCB (2005). *Ambient Air Quality Data, India*. Central Pollution Control Board, India. <http://www.cpcb.nic.in/bulletin/del/2004/delhi2005.htm>

UNDP, World Bank (2004). *Toward Cleaner Urban Air in South Asia: Tackling Transport Pollution, Understanding Sources*. United Nations Development Programme, The World Bank

Qadir, N. F. (2003). *Air Quality in Urban Areas in Pakistan versus Transport Planning: Issues and Management Tools*. United Nations Economic and Social Commission for Asia and the Pacific. http://www.unescap.org/esd/environment/kitakyushu/urban_air/city_report/NQadir1.pdf

SANDEE (2006). *Valuation of Urban Air Pollution: a Case Study of Kanpur City in India*. South Asian Network for Development and Environmental Economics. http://www.sandeeonline.org/publications/working_papers/wp17/working_paper_17.pdf

Sri Lanka Ministry of Transport (2000). *Paper to the Global Initiative on Transport Emissions Workshop 2000*. <http://www.un.org/esa/gite/iandm/jayaweera.pdf>

UNEP (2002). *The Atmospheric Brown Cloud: Climate and Other Environmental Impacts*, Centre for Clouds Chemistry and Climate, United Nations Environment Programme. <http://www.rrcap.unep.org/abc/impactstudy/>

UNEP (2004). *Environmental Indicators South Asia*. Regional Resource Centre for Asia and the Pacific, United Nations Environment Programme, <http://www.rrcap.unep.org/indicator/ISA.pdf>

World Bank (2003). *South Asia Urban Air Quality*, Management Briefing No. 13. The World Bank. [http://Inweb18.worldbank.org/SAR/sa.nsf/Attachments/Briefing13/\\$File/Briefing_Note_No_13.pdf](http://Inweb18.worldbank.org/SAR/sa.nsf/Attachments/Briefing13/$File/Briefing_Note_No_13.pdf)

World Bank (2005). *World Development Indicators 2005*. The World Bank. <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,contentMDK:20523710~HIPK:1365919~menuPK:64133159~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html>



In the face of rapid industrial growth, partnerships between governments, industry and the public are vital to reduce air pollution

Photograph: Development Alternatives



Water

Freshwater is a finite, renewable yet vulnerable natural resource catering to needs of multiple stakeholders for a range of purposes such as domestic water supply, irrigation, hydropower, and industrial production. The Hindu Kush-Himalayan region (HKH) is one of the largest storehouses of fresh water in the world, and its mountains are the source of major river systems that serve about 500 million people in South Asia. However, access to clean water remains one of the major challenges for the region, even though the water availability is high, theoretically. This is partly due to the seasonal nature of the water supply, and largely because of degrading water quality. Significant disparities exist between rural and urban services, which continue to contribute to the burden of life in rural areas. People, who live in the informal, overcrowded peri-urban settlements spawned by urbanization, also have especially, low coverage.

Most of the large rivers in South Asia pass through more than one country. In order to be able to formulate effective policies and to plan, it is necessary to have reliable data on the status and trends of a range of environmental indicators from the whole of a river basin, which means the sharing of information among countries. The severe shortage of reliable data on environmental indicators, and especially on water quality, is hindering attempts to address water issues in the region.

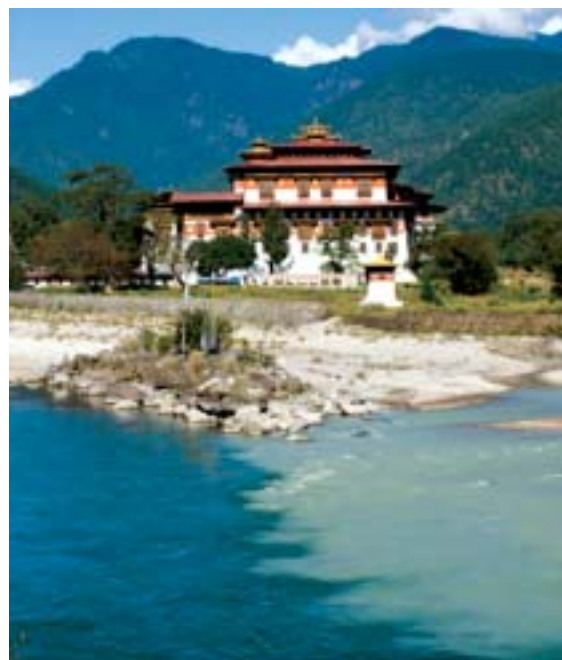
Glacial melt

Himalayan glaciers form the largest body of ice outside the polar caps and are the source of water for the innumerable rivers that flow across the Indo-Gangetic plains. Himalayan glacial snowfields store about 12 000 km³ of freshwater. About 15 000 Himalayan glaciers form a unique reservoir, which supports perennial rivers such as the Indus, Ganges and Brahmaputra, which, in turn, are the lifeline of millions of people in South Asian countries (Bangladesh, Bhutan, India, Nepal, and Pakistan)

Glaciers in the Himalaya are receding faster than in any other part of the world and, if the present rate continues, the likelihood of them disappearing by the year 2035, and perhaps sooner, is very high if the global warming continues at the current rate. Its total area will likely shrink from the present 500 000 to 100 000 km² by the year 2035 (WWF 2005).

Water stress

Water stress is cited as one of the most pressing environmental problem facing the region, where the number of people living



Two rivers merge near the Punakha Dzong in Bhutan

Photograph: istockphoto.com

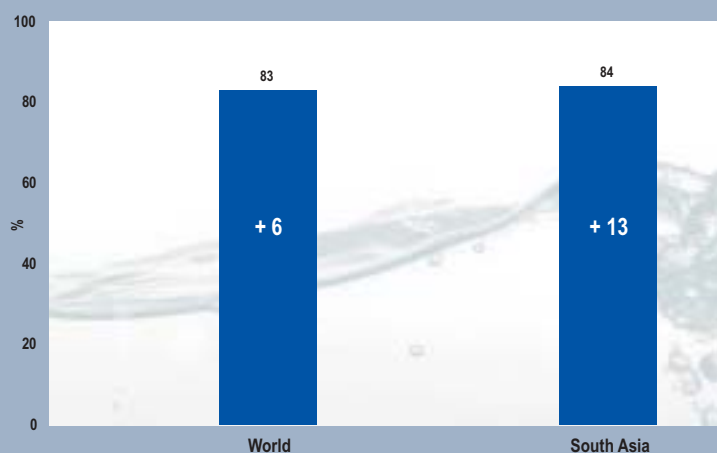
under water stress is expected to increase substantially. In India, "gross per capita water availability" will decline from around 1,820 cubic metres a year to as low as around 1,140 cubic metres a year in 2050 (Cruz et al. 2007).

Box 4: Safe and Improved Drinking Water Sources

An improved water source includes any of the following types of drinking water sources: household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collection. Improved water sources are more likely to provide safe drinking water than unimproved sources, but are not a direct measure of 'safe' drinking water. National percentages of access to a 'safe' water supply are likely to be lower than the figures reported here.

Source: WHO 2006

Figure 27: Coverage with improved drinking water sources in 2002



Source: WHO, UNICEF 2004

Photograph: istockphoto.com

Improved water for health security

South Asia has shown an increased coverage of 13 per cent to improved water sources as compared to the world average of 6 per cent (figure 27). Some 457 million more people have gained access to drinking water supply in Southern Asia between 1990 and 2004 (figure 28).

The most noticeable increase has been in rural areas with a 15 per cent increase (+ 305 million), whereas in urban settings the increase has been of around 4 per cent (+ 153 million).

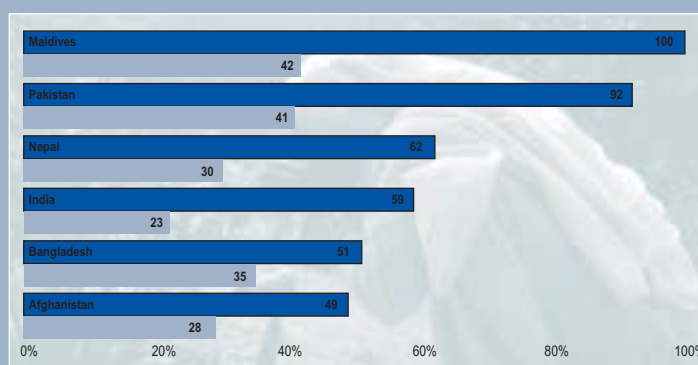
Water poverty index

The Water Poverty Index (WPI) measures the impact of water scarcity and water provision on human populations in a country. WPI is a number between 0 and 100, where a low score indicates water poverty and a high score indicates good water provision. The WPI for South Asia varies from 53 in India to 58 in Pakistan (figure 29).

Low sanitation coverage

South Asia's sanitation coverage (table 6) is among the lowest in the world, at 37 per cent,

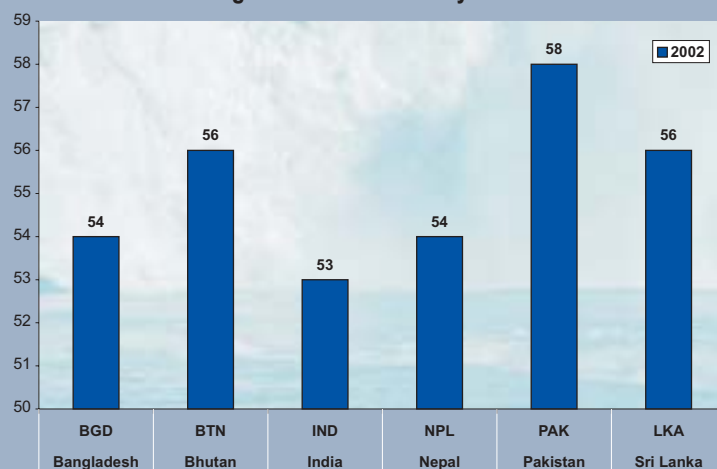
Figure 28: Access to safe drinking water sources



Source: UNICEF 2006

Photograph: Manta Sidhu

Figure 29: Water Poverty Index



Units: Index Number 0-100; lower scores indicate water scarcity and poor water provision

Source: Centre for Ecology and Hydrology 2002.

Photograph: istockphoto.com

about the same as that in sub-Saharan Africa. The 921 million people in the region who live without any toilet facilities represent more than a third of the world's total

The situation is of particular concern for the region's children. Under-five mortality in South Asia is the highest in the developing world outside sub-Saharan Africa.

In South Asia, India has shown the maximum percentage increase in sanitation coverage from the period of 1990 - 2002, although the access to sanitation was still as low as 30 per cent in 2002. However, South Asia has shown a 17 per cent increase in sanitation coverage between 1990 and 2002.

Table: 6: Sanitation Coverage in South Asia

Country	Sanitation coverage (%)		Increase (%)
	1990	2002	
India	12	30	150
Nepal	12	27	125
Bangladesh	23	48	109
Pakistan	38	54	42
Sri Lanka	70	91	30

Source: WHO, UNICEF 2004

In sanitation coverage, South Asia has the most severe urban-rural disparities in the world. Moreover, while the number of people in urban areas without access to sanitation increased from 139 million in 1990 to 153 million in 2004, urban populations are more than twice as likely as rural populations to have access to sanitation.

In contrast, for access to improved drinking-water sources (figure 28) South Asia almost halved the urban-rural gap from 1990-2004.

Water pollution

Over the years, water pollution has emerged as a major issue in South Asia. Pollutants include pathogens, organic

matter, nutrients, heavy metals and toxic chemicals, sediment and suspended solids, silt and salts. 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 has 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 sediment 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).



A polluted waterway in India

Photograph istockphoto.com

Arsenic contamination

In many areas of South Asia, naturally

occurring arsenic and fluoride contamination are threatening to reverse the gains made in providing improved drinking water. Unsafe levels of arsenic have been detected in Bangladesh, India, Nepal, Pakistan and other countries.

Groundwater in districts of West Bengal, India, and in some villages of Bangladesh, for example, is contaminated with arsenic at levels as much as 70 times higher than the national drinking water standard of 0.05 mg/litre (Table 7). The problem is greatest in Bangladesh.

Transboundary water resources

Three of the world's mightiest rivers flow through countries of the Indian subcontinent. (Table 8) The Indus River system is the largest, contiguous irrigation system in the world with a command area of 20 million hectares and an annual irrigation capacity of over 12 million hectares. The Ganges-Brahmaputra-Meghna region comprises of the catchments areas of three major river systems that flow through India, Nepal, Bhutan, China and Bangladesh. This

Box 5: Affecting Millions in Bangladesh: Arsenic in Groundwater

Of the regions of the world with groundwater arsenic problems Bangladesh is the worst case identified, with some 35 million people thought to be drinking groundwater containing arsenic at concentrations greater than 50 µg L⁻¹ and around 57 million drinking water with concentrations greater than 10 µg L⁻¹ (Gaus and others 2003). The large scale of the problem reflects the large area of affected aquifers, the high dependence of Bangladeshis on groundwater for potable supply, and the large population in the fertile lowlands of the Bengal basin.



Arsenic is a new and unfamiliar problem

Photograph: Development Alternatives

Source: World Bank 2005

system is second only to the Amazon with an annual discharge of 1 350 billion cubic meters and a total drainage area of 1.75 million square km. With a population of over 600 million people living in the region, which is growing at an annual rate of 2 per cent, there is considerable pressure on the region's resources. The Mahakali River flows along the Nepal-India western border. Table 9 shows the major river basins in South Asia. The river was fixed as the western boundary between Nepal and British India in 1816. Nepal's rivers have the potential to generate 83 000 MW of electricity through hydropower generation, most of which could be exported to India to meet its growing energy needs - northern India currently faces a power deficit of 9 500 MW, which is expected to rise to 20 000 MW by 2010. Although both countries have reached numerous water resource development agreements, Indo-Nepali cooperation on the river systems has been slow.

Table 7: Summary of the Distribution, Nature, and Scale of Documented Arsenic Problems (>50 µg-1) in Aquifers in South and East Asia

Location	Area extent (km ²)	Population at risk*	Arsenic range (µg L ⁻¹)
Bangladesh	150 000	35 000 000	<1-2 300
India (West Bengal)	23 000	5 000 000	<10-3 200
Nepal	30 000	550 000	<10-200
Pakistan (Southern Punjab and Central Sindh)	300 000	7 400 000	<50-1 000

Source: World Bank 2004

Table 8: The Three Main Rivers in South Asia

	Brahmaputra	Ganges	Indus
Length	2 900 km	2 510 km	3 180 km
Source	Kailas range, Himalayas	Gangotri glacier, Himalayas	Kailas range, Himalayas
Mouth	Merges with the Ganges, then into the Bay of Bengal	Merges with the Brahmaputra, then into the Bay of Bengal	Arabian Sea
Countries	Bangladesh, China, India	Bangladesh, India	China, India, Pakistan
Population	300 million (including the Ganges)	300 million (including the Brahmaputra)	150 million (around the basin)

Source: UNESCO 2001

Table 9: Major River Basins in South Asia

Basin Name	Total area of basin (sq km)	Country	Area of basin (sq km)	Area of basin (%)
Ganges-Brahmaputra-Meghna	1,634,900	India	948 400	58.01
		China	321 300	19.65
		Nepal	147 400	9.01
		Bangladesh	107 100	6.55
		China, India	67 100	4.11
		Bhutan	39 900	2.44
		China, India	1 200	0.07
		Myanmar (Burma)	80	0.00
Indus	1,138,800	India, Pakistan	597 700	52.48
		India, Pakistan	381 600	33.51
		China	76 200	6.69
		Afghanistan	72 100	6.33
		China, India	9 600	0.84
		China, India	1 600	0.14
		Nepal	10	0.00

Source: ASIA: International River Basin register (updated August 2002)

References

- Ageta, Y. and Iwata, S. (1999). *The Assessment of Glacier Lake Outburst Flood (GLOF) in Bhutan*. Report of Japan-Bhutan Joint Research 1998. Institute of Hydrospheric-Atmospheric Sciences of Nagoya University.
- Centre for Ecology and Hydrology (2002). *The Water Poverty Index: International Comparisons*. <http://www.nerc-wallingford.ac.uk/research/WPI/images/wpaper.pdf>. Wallingford: Centre for Ecology and Hydrology.
- Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalma, Y. Honda, M. Jafari, Li, C. and Ninh, N. H. (2007). Asia. ClimateChange 2007: Impacts, Adaptation and Vulnerability. In *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Eds.) M.L. Parry,
- Dyrugerov, M.B. and Meier, M.F. (1997). *Mass balance of Mountain and Sub-polar Glaciers: A New Global Assessment for 1961-1990*, Arctic and Alpine Research, 29(4), pp. 379-391.
- Gaus, I., Kinniburgh, D. G., Talbot, J. C. and R. Webster, R. (2003). Geostatistical Analysis of Arsenic Concentration in Groundwater in Bangladesh Using Disjunctive Kriging. *Environmental Geology* (44) pp. 939-948.
- Jha, R. (u.d.) *Alleviating Environmental Degradation in the Asia-Pacific Region: International cooperation and the role of issue-linkage*. Research School of Pacific and Asian Studies, Australian National University

- MEC (2004). *State of the Environment Maldives 2004*. Ministry of Environment and Construction. Male'.
- Pierce, F. (2001). Death in a Glass of Water. *The Independent, UK*. 19 January <http://www.arsenicfilters.com/glass.htm>.
- Salam, S.M.A., Uprety, K. (2003). *Conflict and Cooperation on South Asia's International Rivers: A Legal Perspective*. The World Bank.
- Tandong, Y.; Shiyin, L.; Jianchen, P.; Yongping, S. and Anxin L. (2004). *Recent Glaciers Retreating in High Asia and their Impact on the Water Resources of Northwest China*. *Science in China*. (in press)
- UNEP (2001). *State of Environment South Asia 2001*, United Nations Environment Programme.
- UNESCO (2001). United Nations Educational and Scientific Organisation. http://www.unesco.org/courier/2001_10/uk/doss08.htm#top
- UNICEF, WHO (2004). World Health Organization and United Nations Children's Fund.
- UNICEF (2006). *Progress for Children 2006*. A Report Card on Water and Sanitation: Number 5. United Nations Children's Fund
- WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (u.d.). World Health Organization and United Nations Children's Fund.
- WHO (2006). *World Health Report 2006*: Annex Table 3. Geneva: World Health Organization. Available online at: <http://www.who.int/whr/2006/annex/en/index.html> and in the WHO Statistical Information System (WHOSIS): Core Health Indicators.
- World Bank (2005.). *Towards a more Effective Operational Response : Arsenic Contamination of Ground Water in South and East Asian Countries*. Technical Report Volume II. The World Bank
- WWF (2005). *An Overview of Glaciers, Glacier Retreat, and Subsequent Impacts in Nepal, India and China*, WWF Nepal Program, March, 2005.



Biodiversity

South Asia is renowned for its spectacular natural beauty and biological wealth. The region's geographical expanse and topography include several diverse ecosystems that harbour a rich variety of faunal and floral species. The Sunderbans, in India and Bangladesh, form the largest contiguous mangrove swamp in the world. There are magnificent coral reefs and atolls in the Lakshadweep-Maldives chain of islands. The Thar Desert and other arid areas occupy northwestern India and southern Pakistan. High altitude cold deserts are found in the upper Himalayas and Deosai plains of Kashmir. Three rich biodiversity hotspots are: in the eastern Himalayas in Nepal, northeastern India, and Bhutan; the Western and Eastern Ghats of India and Sri Lanka; and the Indo-Burma hotspot in India and Myanmar. There are dense and virtually untouched virgin forests in Bhutan and the Sinharaja, an UNESCO World Heritage Site, is an ancient rain forest in Sri Lanka. India has been ranked among the world's 12 mega-diverse countries and Sri Lanka is also among the most biologically diverse countries in the world.

Biological wealth

Approximately 14 per cent of the world's remaining mangrove habitation is found in South Asia, in addition to the highest percentage of threatened wetlands, 82 of which are in Bangladesh. The Himalayas are an important ecosystem, with the Hindu Kush Himalayan belt being home to about 25 000 major plant species, comprising of ten per cent of the world's flora. The Sundarbans, found in the Brahmaputra delta, are among the world's most significant mangrove forests and is the habitat of the Royal Bengal Tiger. The highest percentage of threatened plants is reported in Sri Lanka; the wetlands in the Brahmaputra and Ganges plains are under threat; and the Sundarbans are being eroded due to pressure from human settlements and shrimp farming. More efforts to preserve the biological wealth of South Asia are needed.

Protected areas

Apart from numerous biosphere reserves, national parks and wildlife sanctuaries, three biodiversity hotspots have also been identified in South Asia. These areas are extremely rich in species, have high endemism, and are under the threat of extinction. They are not only rich in terms of flowering plants but also in reptiles, amphibians and some mammals. Wetlands provide refuge to a large number of migratory birds and local species and to address the issue of conservation, those of international importance have been identified and a list has been prepared and these are protected under the Ramsar Convention. One of the measures taken for the conservation of marine biodiversity is the identification of



Fifteen scientifically recognized subspecies of the green caterpillar, Polyura athamas, exist in South Asia

Photograph: Rishi Kumar

Marine Protected Areas (MPAs) that serve as breeding grounds for marine animals and are essentially critical for the wellbeing of marine ecosystems.

Biodiversity hotspots

Biodiversity hotspots in South Asia can be divided into three categories.

- Category I:** The Western Ghats of southwestern India and the highlands of southwestern Sri Lanka
- Category II:** The Indo-Burma Hotspot, which formerly included the Himalayan chain and the associated foothills in Nepal, Bhutan and India. It has now been more narrowly redefined as the Indo-Chinese sub-region.
- Category III:** The Himalayan Hotspot stretches in an arc of over 3 000 kilometres over northern Pakistan, Nepal, Bhutan and the northwestern and northeastern states of India, the Himalayan Hotspot includes all the world's mountain peaks that are higher than 8 000 meters. This includes the world's highest mountain, Everest (*Sagarmatha*), as well as several of the world's deepest river gorges.

Table 10: Categories of Hotspots

Categories	I	II	III
Hotspot Original Extent (km ²)	189 611	2 373 057	741 706
Hotspot Vegetation Remaining (km ²)	43 611	118 653	185 427
Endemic Plant Species	3 049	7 000	3 160
Endemic Threatened Birds	10	18	8
Endemic Threatened Mammals	14	25	4
Endemic Threatened Amphibians	87	35	4
Extinct Species †	20	1	0
Human Population Density (people/km ²)	261	134	123
Area Protected (km ²)	26 130	235 758	112 578
Area Protected (km ²) in Categories I-IV *	21 259	132 283	77 739

Note: †Recorded extinction since 1500. *Categories I-IV of IUCN affords higher levels of protection.

Source: CI 2006

Ramsar sites

The original objective of the Ramsar Convention was to protect water-bird habitats. The convention has broadened its scope to include the protection of all wetland biodiversity and the 'wise use' of all wetlands, which include both coastal and forest wetlands.

Many of the wetlands in Afghanistan are completely dry and no longer support wildlife populations or provide agricultural inputs. For example, over 99 per cent of the Sistan wetland was found to be completely dry in the winter of 2002 (UNEP 2003).

Table 11: Ramsar Sites

Country	ISO	2005
Bangladesh	BGD	2
India	IND	19
Nepal	NPL	4
Pakistan	PAK	19
Sri Lanka	LKA	3



Source: The Bureau of the Convention on Wetlands 2005.

Photographs: istockphoto.com

Table 12: Nature Conservation Sites in South Asia – UNESCO World Heritage Sites

Bangladesh	The Sunderbans (1997)
India	Kaziranga National Park, Assam (1985) Keoladeo National Park, Rajasthan (1985) Manas Wildlife Sanctuary, Assam (1985) Nanda Devi and Valley of Flowers National park, Uttaranchal (1988, 2005) Sunderbans National Park, West Bengal (1987)
Nepal	Sagarmatha National Park (1979) Royal Chitwan National Park (1984)
Sri Lanka	Sinharaja Forest Reserve (1988)

Biodiversity rich nature conservation sites are also present in Bhutan and Pakistan, which have the potential to be recognized as World Heritage Sites by UNESCO.

Source: UNESCO 2007

Marine conservation efforts

The South Asian Seas (SAS) region can be categorized into two distinct geographical groups. While Maldives and Sri Lanka are island nations, Bangladesh, India and Pakistan are situated on the Asian mainland.

The region has some of the largest and biologically rich marine ecosystems, such as the Gulf of Mannar, Atolls of Maldives and Mangroves of Sundarbans. The presence of perennial rivers such as the Brahmaputra, Ganges, Godavari, Indus, Kelani, Magna, etc. have contributed to large networks of backwaters, estuaries, salt marshes and mangroves.

The SAS also provides habitats for endangered marine turtles, for example the Green and Olive Ridley turtles. Some of the largest coastal lagoons of the world such as Chilka Lake in India and Puttalam lagoon in Sri Lanka are located within the region. It has one of the world's finest coral ecosystems, with atolls constituting the entire country of Maldives.

The need for Marine Protected Areas (MPAs) covering coral reefs has been recognized by governments, so as to: promote activities that demonstrate the way conservation and development can reinforce each other in marine and coastal environments; conserve marine and coastal species and ecosystems; enhance awareness of marine and coastal conservation issues and management; and mobilize the global conservation community to work for marine and coastal conservation. But commitments to the management of existing MPAs and the planning for new areas are still inadequate to ensure conservation of coral reef resources.

About six per cent of the world's coral reefs are found in South Asia and these provide food and livelihood sustenance to an estimated 400 million people. The Maldives comprise perhaps one of the world's most complex reef systems with 1 300 low coral islands and sandbanks, while the Chagos Archipelago has the largest and some

of the most diverse undisturbed reefs in the Indian Ocean including the world's largest atoll - the Great Chagos Bank - and many areas of endemic coral. The tiny Lakshadweep Islands are built on top of coral reefs and covered by coral sand.

Marine protected areas

The South Asian region was ranked the lowest in the world in terms of declared Marine and Coastal Protected Areas (MCPAs) in the 2003 United Nations List of Protected Areas, making the Indian Ocean - with its wealth of coral reefs, sea-grasses, and mangrove forests - perhaps, the most poorly protected coastline. As a result, the degradation of coastal and marine resources continues at an unprecedented



A batfish among the reefs in the Maldives

Photograph: istockphoto.com

Box 6: Status of Marine Protected Areas in South Asia			
Marine Protected Areas	MPA Status	MPA Management	Major issues
Bangladesh St. Martin's Island (in National Conservation Strategy protected area programme)	Small coral reefs & scattered coral growth on limestone, rocky habitats: corals and other reef resources rapidly degrading	Management weak due to single sector approach: lack of trained manpower in coastal and marine affairs for enforcement & management	Sedimentation, coral mining, mangrove cutting, pollution, over-exploitation. No progress since 2000
Chagos (B.I.O.T.) Several protected areas: 1 Ramsar site. Management plan being prepared to recommend extension of strictly protected areas.	Massive mortality in 1998. Extensive new coral recruitment from surviving patches: mostly on eroding table coral & rubble substrate	Diego Garcia Strict Nature Reserves and Ramsar site currently effective: Some recreational fishing allowed. All other strict nature Reserves no-entry areas: no human disturbance.	No specific major issues as archipelago uninhabited; good compliance in Diego Garcia
Indian mainland Gulf of Mannar Biosphere Reserve (1989)	Some areas highly degraded: damaged in 1998 bleaching, damage continues due to over-exploitation & sedimentation	Action Plan prepared: weak management. No buffer zones & management.	Coral & sand mining, over-exploitation, sedimentation & industrial pollution. No progress since 2000
Gulf of Kutch Marine National Park(1980)	Heavily degraded	Action Plan prepared but weak management. No buffer zones, & possible losses for industrial development	Coral mining, mangrove cutting, industrial pollution and sedimentation. No progress since 2000.
Ladshadweep One national park declared	Corals not recovered after the 1998 bleaching.	Management is weak	Subsistence fishing & coral mining. No progress since 2000.
Andaman & Nicobar Islands Mahatma Gandhi marine National Park, (Wandur National Park) Andaman Islands (1983)	Coral reef resources relatively well protected.	Action Plan has been implemented	Sedimentation, crown-of-thorns starfish, tourism & souvenir collecting. No progress since 2000
Rani Jansi Marine National Park, Ritchie's Archipelago (1997)	No information	Action Plan has been implemented	No information. No progress since 2000
Maldives 25 MPAs established. (15 Sites in 1995) (10 Sites in 1998)	Good condition except for 1998 bleaching massive coral losses.	All are tourist & popular dive sites. Little active management or enforcement. Lower human impacts than other countries in region.	Boat anchoring, dive tourism, crown-of-thorns starfish, conflicts between tourism & fisheries users. No progress since 2000
Sri Lanka Hikkaduwa Nature Reserve (1979 upgraded in 1998)	Very poor condition. 7% coral cover in 1999, poor recovery except some large corals.	Management plan exists since 1996, no active management. MPA zones lost due to lack of maintenance	Sediments, physical damage by glass bottom & fishing boats, reef trampling, sewage pollution
Bar Reef Marine Sanctuary(1992)	Shallow coral areas highly degraded in 1998 bleaching, no management.	Management issues identified, recommendations made	Crown-of-thorns starfish, over-exploitation of fish, ornamental fish. No progress since 2000

Source: AIMS 2003

Photographs: istockphoto.com

rate, and despite current protection measures, between one-third and half of coral reefs, in South Asia are effectively dead, and a further per cent threatened.

The impacts of tsunami and other stresses on coral reefs

The earthquake on 26 December, 2004 resulted in major, but localised damage to some coral reefs. Damage occurs when an earthquake fractures the reef and shatters fragile corals or lifts a coral reef out of the water (Simeulue Island, Sumatra and Andaman Islands). The tsunami following the earthquakes damaged coral reefs through three mechanisms: wave action which dislodged, smashed and moved coral and rubble; smothering of corals by increased sediment movement; and mechanical damage and smothering by debris from the land. The effects were very localised with some areas seriously damaged, whereas large areas of adjacent coral reef were either slightly affected or undamaged. In most of these countries, the tsunami washed directly over coral reefs, which may have provided a limited protection



Coral reefs are of great economic importance in the Maldives

Photograph: istockphoto.com

to the land behind. There is anecdotal evidence that there was more damage on land behind coral reefs that had been extensively mined – for example, in Sri Lanka – than in areas where the reefs were intact. However, the protection was minimal where the waves were particularly large. In contrast, mangrove forests and other coastal vegetation were particularly effective in minimising the damaging effects of the waves on land and also in trapping large items of debris.

Tsunamis and earthquakes are natural stresses that damage reefs and have affected coral reefs for millions of years. Coral reefs have evolved with these stresses, along with volcanoes, tropical storms, freshwater inundation, plagues of predators

and diseases. They normally recover naturally if the stresses are not too severe, repetitive, or compounded by other threats.

In all Indian Ocean countries, tsunamis have caused less damage to coral reefs than the cumulative direct anthropogenic stresses such as over-fishing, destructive fishing, sediment and nutrient pollution, and unsustainable development on or near them. Moreover, many of the coral reefs in these countries were extensively damaged during the El Niño global climate change event of 1998, when about 90 per cent of the world's corals were destroyed by coral bleaching.

Tsunamis have compounded the damage from 1998 by killing some newly settled corals and by hurling around the coral rubble produced after much of the live coral was killed by coral bleaching. Other climate change factors, such as a potential increase in storm strength and frequency and an increase in ocean acidity, pose greater threats to reefs in the future than natural disturbances.

The most important conclusion from most countries was that there was insufficient awareness of the value of ecosystem goods and services and management capacity to conserve the coral reefs and mangroves from ongoing human damage. While the tsunami in 2004 resulted in some severe impacts, ongoing human pressures, such as deforestation and destructive fishing practices, prior to the tsunami caused more damage than the tsunami. All countries recommended stronger conservation and protection of their coral reefs and other coastal resources to guarantee the sustainable provision of goods and services and also to enhance their resistance and resilience against natural disturbances.

As per the action plan the states are required to focus specifically on Integrated Coastal Zone Management (ICZM); Development and Implementation of National and Regional Oil and Chemical Spill Contingency Planning; Human Resources Development through Strengthening Regional Centres of Excellence; and Protection of the Marine Environment from Land-based Activities. This, however, does not preclude venturing into other areas.

The scope of ICZM for the SAS is being expanded to promote the Integrated Coastal Area and River Basin Management (ICARM) concept. In addition the SAS Secretariat has worked with a number of coral reef initiatives to promote the better management of the regions' coral reefs

Variance in protected areas

Protected areas encompass an area of roughly 211 000 sq km in the region. The percentage of protected area coverage varies greatly among countries. Bhutan has set aside 39.5% of its land under protection and the country is among the top ten countries in the world with the highest proportion of land under protected areas, whereas in Bangladesh the area is extremely low (Figure 30). The legal status of all protected areas in Afghanistan is currently in question, and no management is taking place to protect and conserve their ecological integrity and wildlife.

The lowest per capita forest cover is found in the South Asian sub-region where it is around 0.08 hectares per person, which is also substantially lower than the regional figure of 0.21 hectares per capita. It was estimated in 1989 that, at the current levels of consumption of forest produce and of forest productivity, every Indian citizen would require at

least 0.47 hectares of forest to meet their basic needs (Figure 31).

In Afghanistan, in recent years, forest cover has diminished, due to community demands for fuel wood and illegal logging. It is estimated that offtake rates are exceeding annual growth rates leaving a deficit of about 30,000 ha of forest per year. If nothing is done, Afghanistan will have very little natural forest or its associated wildlife left in 15 years time.

Deforestation

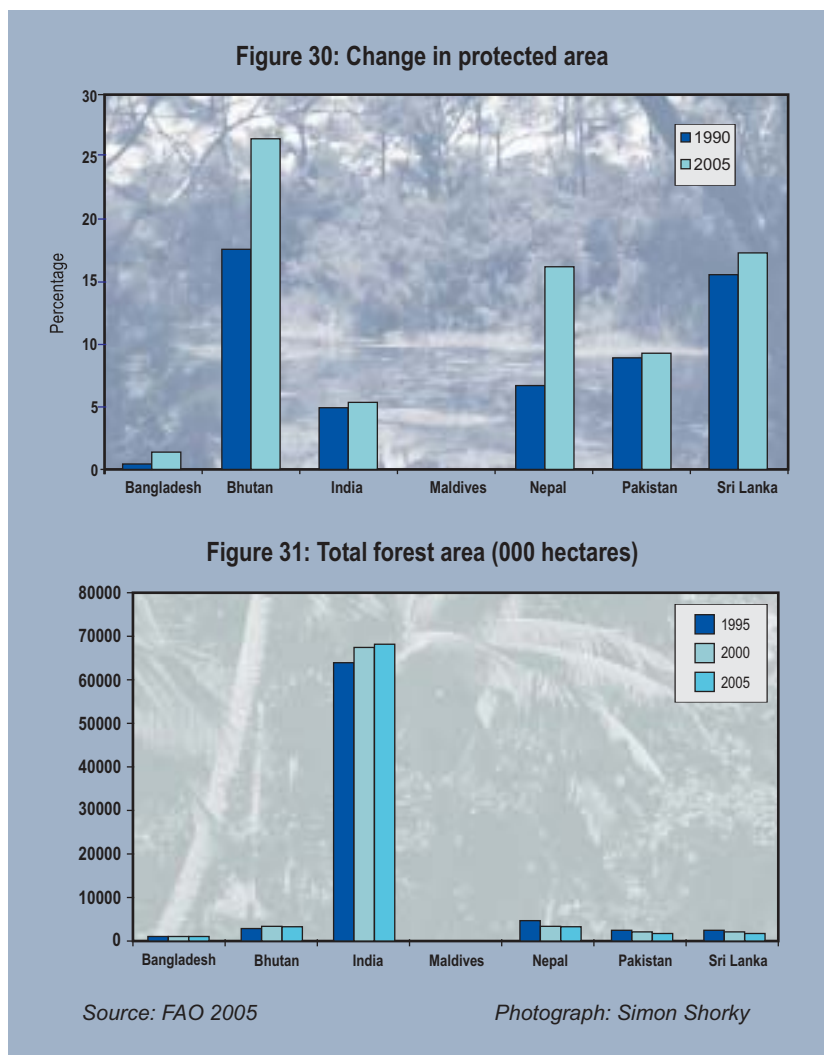
The sub-region has apparently been successful in lowering the rate of deforestation in the past decade even though it suffers from pressures like scarcity of forest land, poverty and high population levels. The major concern is human-induced degradation of forests and other natural resources that ultimately threaten the sustainability of life, livelihoods and long-term development. The countries in the sub-region are working hard to lower the population growth rate and increase the economic growth rate to provide additional employment and income for its citizens.

Threatened species

Birds, mammals and plants

The number of threatened bird and mammal species has increased over the years in all regions of South Asia, despite an increase in protected areas (Figures 32 and 33). This may be attributed to an increase in illegal trade of animals and hunting; and degradation and fragmentation of the habitat due to increasing urbanization and consumerism pressures, due to the rapidly increasing population. Although the population growth rate has declined, population is still high due to the better longevity as health care services have improved. There is a general consensus that the natural resources of Afghanistan, and biodiversity in specific, are in poor shape. The natural wildlife heritage of the country is also under threat. For example flamingos have not bred successfully in Afghanistan for four years, and the last Siberian crane was seen in 1986. While the Wakhan Corridor contains healthy populations of endangered snow leopards and other mammals including Marco Polo sheep, active hunting is occurring in many regions of the country, either for sport, for meat, or in order to supply furs for sale to foreigners in Kabul. There are no custom controls or trade policy that deals with the imports of banned toxic chemicals and hazardous wastes, as well as exports of endangered wildlife and illegally harvested timber. Therefore, the customs regulations and control practices and training to the custom officers to detect illegal products to prevent illegal trade are the present day's dire need (UNEP 2003).

The number of threatened plant species has decreased and this can be attributed to an increase in protected areas and forest cover (Figures 34).



Marine diversity

Another factor contributing to the decline of biodiversity, particularly the marine diversity, is degradation of the marine habitat due to climate change, coral bleaching, overexploitation of resources and environmentally hazardous techniques of fishing, all of which contribute to the degradation of the entire ecosystem. Early settlement of the land and maritime boundary issue in the Sir Creek between India and Pakistan would help check over exploitation of fishing reserves and conservation of marine diversity.

Increased economic activity, greater biological losses

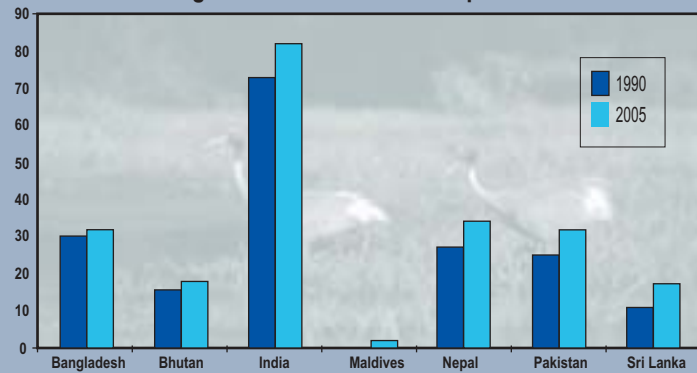
Most forms of sustained human activity result in some modification of the natural environment and this will affect the relative abundance of species and may lead to extinction, in extreme cases. This may result from the habitat being made unsuitable for the species such as clear-felling of forests and severe pollution of rivers, or through the fragmentation of the habitat. The latter has the effect of dividing previously contiguous populations of species into small sub-populations. If these are sufficiently small, then the process lead to increasing probabilities of species extinction, within a relatively short time. A major, though at present, largely unpredictable change in natural environments is likely to occur within the next century as a result of large-scale changes in global climate and weather patterns. The probability that these will cause greatly elevated extinction rates is highly probable, although their exact effects are unknown at present.

Other factors contributing to the loss of biodiversity

1. Population increase and conversion to other land uses

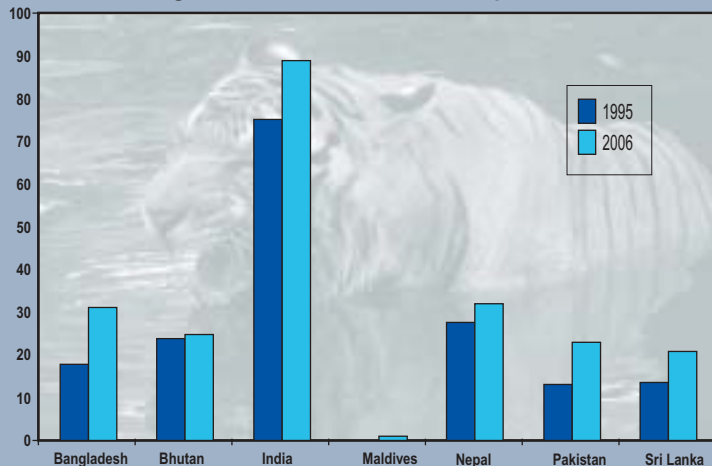
- ❖ Habitat destruction/ deforestation, loss of wetlands
- ❖ Overexploitation/ use of hazardous techniques destructive to the entire ecosystem, an example of which is coral mining.
- ❖ Pollution

Figure 32: Threatened bird species



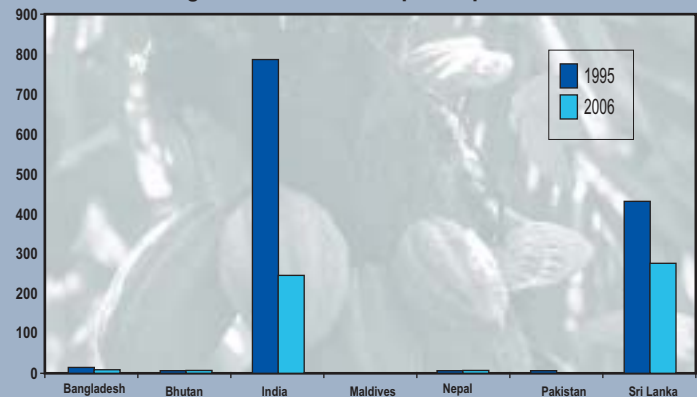
Photograph: istockphoto.com

Figure 33: Threatened mammal species



Photograph: Karunakar Rayker

Figure 34: Threatened plant species



Source: IUCN 1995, 2006

Photograph: Karunakar Rayker

- ❖ Species introduction
- ❖ Increased International trade
- ❖ Global climate change
- ❖ Unsustainably high rates of natural resource consumption and human population growth

2. *Lack of Understanding of Scientific Management*

- ❖ Economic systems and policies that fail to value the environment and its resources
- ❖ Inequity in ownership and access to natural resources, including the benefits from use and conservation of biodiversity
- ❖ Inadequate Knowledge or lack of baseline information on bio-diversity for decision making
- ❖ Legal and institutional systems that fail to protect against unsustainable exploitation.

3. *Tourism pressures*

4. *Under-Valuation of Biodiversity*

- ❖ The valuation of biodiversity and its recognition in economic terms is still new. There is relatively little difficulty in valuing products from natural ecosystems that come into the market. However, their service values such as



Box 7: Ensuring Sustainable Ornamental Fishing in Sri Lanka

The marine ornamental fish industry in Sri Lanka has expanded rapidly over the last 20 years. There are between 200 and 300 marine species of fish and invertebrates that are exported for aquarium purposes. There is, however, no monitoring or management of the trade at present, and reports of over-exploitation and habitat destruction are common.

The Sri Lanka Marine Ornamental Fishery Project, carried out by the National Aquatic Resources Development Agency (NARA) in collaboration with the Marine Conservation Society (UK), aims to ensure that, in the long term, marine ornamental fishery is sustainable and that conservation of marine bio-diversity is promoted. The project, which is scheduled to run from 1995 to 1998, includes the following activities:

- ❖ Surveys of coral reef fish and invertebrate populations to obtain information on abundance, recruitment and distribution patterns. The conditions of the reefs and associated marine habitats will also be noted.
- ❖ A socio-economic survey of the user communities.
- ❖ Preparation of illustrated manuals on important ornamental species to assist divers, fishery field officers and custom officers to identify these species.
- ❖ Training courses and workshops for those involved in the trade.
- ❖ Fishery survey and community involvement to increase management options and ensure the conservation of marine biodiversity in the long term.

The project has been progressing quite smoothly, and up to June 1997, dive surveys of near-shore and off-shore reefs had been carried out at approximately 30 sites along the southern and western coasts of Sri Lanka and information gathered on different species in the trade. The socio-economic survey is currently underway and a large number of collectors/divers have been registered with NARA. A handbook on protected marine species in Sri Lanka has been published and two workshops have been held for those in the ornamental fish trade.

Source: MCS/NARA (1996a, 1996b)

Photographs: istockphoto.com

water, soil and genetic resources conservation; amelioration of environment; aesthetic beauty; and the potential for ornamental plants, medicines and food need to be addressed more in economic terms.

Impacts

Loss of biodiversity will impact the ecosystem services upon which human survival is dependant both directly as well as indirectly.

Ecosystem services are the benefits obtained by people from ecosystems. These include:

- ❖ Provisioning services such as food, clean water, timber, fibre, and genetic resources;
- ❖ Regulating services such as the regulation of climate, floods, disease, water quality, and pollination;
- ❖ Cultural services such as recreational, aesthetic, and spiritual benefits; and
- ❖ Supporting services such as soil formation, and nutrient cycling.

Biodiversity plays an important role in the way ecosystems function and in the services they provide. Species composition matters as much or more than species richness in ecosystem services, since the functioning of an ecosystem - and its ability to provide services to humans - is strongly influenced by the ecological characteristics of the most abundant species, and not by the number of species.

Pirating local traditional wisdom

Biopiracy can be used to suggest a breach of a contractual agreement on the access and use of traditional knowledge to the detriment of the provider and bio-prospecting without the consent of the local communities.

The number of cases of biopiracy affecting South Asia is growing steadily, as shown by the examples in Table No. 13.

Value addition to native knowledge is the confirmation by western scientists of the properties of the resource, often known to local communities for years. Unlike the social system in which this knowledge evolves, each the commercial system obtains a profit-oriented monopoly to exploit the product from its origin to the end. Most often, it is the pharmaceutical or agro-chemical companies who market the finished product, that secure patents, irrespective of the fact that the product may have had its origin in traditional knowledge. So, the "first-to-file" gets legally protected rights rather than the "first-to-invent". This can be used to prevent the original inventor from exercising any control over the resource, in question. The issue of protection of traditional knowledge involves preventing unauthorized persons from obtaining rights that are detrimental of the real innovators.

As governments realize the commercial value of genetic resources, they wish to exercise control over them so as to restrict access to these resources. The long history of state control over resources in forest areas and other areas prevents unhindered access to biological resources by the local communities. Even today, the Kani tribe in India has trouble accessing a plant (*Trichopus zeylanicus*) used in the preparation of the herbal medicine "Jeevani", which is



Between one-third and two-thirds of all species could be lost during the second half of the next century

Photograph: Asif Akbar

Table I3: Cases of Biopiracy

Country	Biological Resource	Nationality of Bio-prospector	Patent Application
Pakistan	Basmati Rice (Oryza sativa)	US	US Patent No.s 6274183
India	Basmati Rice (Oryza sativa)	US	US Patent No.s 5663484 and 4522838
India	Turmeric (Curcuma longa)	US	US Patent No. 5401504, 5135796 and 5047100
India	Neem (Azadirachta Indica)	US	Several US Patents including No.s 5420318, 5391779 and 5371254; the US multinational company W.R.Grace's EPO Patent No. 0426257
India	Guggul (Commiphora mukul)	US	US Patent No. 6113949 and US Patent 20020018757
Sri Lanka	Kothala himbutu (Salacia reticulata)	Japan, US	Takama System, Ltd. (Yamaguchi, JP)'s US Patent No. 6,376,682 Shaman Pharmaceuticals Inc. (South San Francisco, CA)'s US Patent No. 5691386

Source: *GRAIN and Kalpavriksh 2002*

grown under the shade of the natural forest canopy. The government does not have any provision towards contributing the collection of this herb. Legally, tribal people cannot access the plant and sell it to the institute that developed the drug, since collection for commercial purposes is not allowed. The Forest Department justifies the restrictions on collection on grounds of conservation of an endemic species, which may run the risk of over-exploitation from commercial demand.

Conservation efforts

The importance of the conservation of wild plant resources is officially recognized by most countries within the region. 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 prevent soil erosion. Within the region, Bhutan has the distinction of being the only country with 72.5 per cent forest cover and nearly 39.5 per cent of its land under protection.

Across South Asia's other nations, there exists an extensive system of protected areas which offer shelter diverse ecosystems and habitats of endangered and endemic species of wildlife. However, because of the ever increasing demand for space to accommodate the rising 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. Insufficient funding, inappropriate equipment and impractical and ineffective management plans often render protective measures futile.

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 through 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 Action 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 Environment and Natural Resources for implementation of

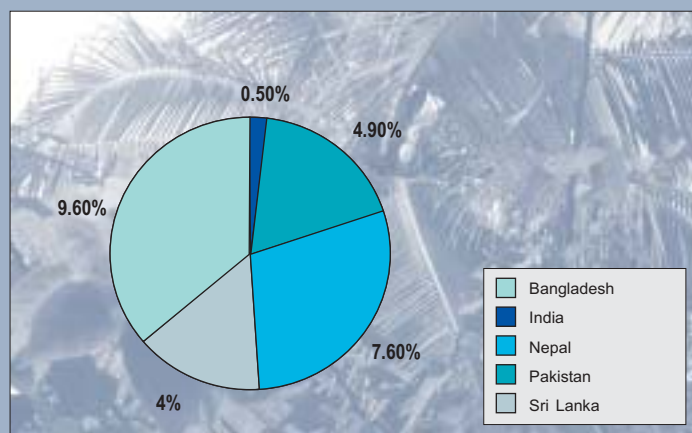
BCAP, and initiatives include development measures for valuation of biodiversity, conservation of medicinal plants, establishment of a legal task force to identify gaps and recommendations in national legislation.

"Wana Senasuna" forest hermitage programme is another initiative by Govt. of Sri Lanka to involve the Buddhist clergy and devotees for protecting the forests with cultural values. It integrates religious and cultural aspects into forest conservation to enhance protection afforded to these areas.

Transboundary protected areas

In recent years, transboundary conservation is receiving greater attention due to nations recognizing their environmental security. Transboundary protected areas are important in this region due to many zones of high biodiversity located along borders, where

Figure 35: Protected area cover in South Asia as a percentage total land area, 2004



Source: UNEP – WCMC 2004

Photograph: istockphoto.com

Box 8: The Chitwan National Park, Nepal: A Category V Buffer Zone

A Buffer Zone (BZ) Regulation was enacted in 1994, allowing park authorities to designate adjoining areas as BZs, and allocate between 30-50 per cent of park revenue for their management. This was done to provide alternative natural resource-based livelihood opportunities to BZ communities, and so reduce their dependence on park resources.

The Chitwan National Park (CNP) BZ was declared in 1996, with an area of 766km² and a population of over 200 000 living in about 510 settlements. About 43 per cent of the BZ is still forested. Some of these forest patches are important as animal refuges and corridors, linking CNP with mountain ecosystems to the north and Indian Wildlife Sanctuaries to the south. CNP and its BZ also contain important cultural and historical sites. The BZ area is inhabited by various indigenous and hill migrant ethnic groups with impressive cultural and religious values and customs.

A co-management approach has been adopted in the BZ. A BZ Development Council (BZDC) links local people and park management, and mobilizes a share of park revenue for conservation and development activities in the BZ, managed through users' committees and groups. User committees submit their bids to BZDC after consultation and endorsement from users' meetings. To date, an income of approximately US\$700 000 has gone to BZ management in this way. Various projects, including UNDP-funded Park and People Project, support this initiative.

Though the BZ is not officially designated as a Category V protected area, its character and management aims are similar.



A buffalo crossing a river at the Chitwan National Park

Photograph: istockphoto.com

Source: IUCN 2002

illegal harvesting is an acute problem. In the Himalayan region, there have been new initiatives to conserve its unique biodiversity.

Transboundary parks and reserves are inhabited by a large number of people who share a common cultural heritage. However, due to the remote mountainous landscape and high-altitude environments, these people are some of the poorest in the world. Reconciling the needs of these local communities and also conserving ecosystems at the same time has become a major challenge in these protected areas.

In South Asia, the most important institutions for conservation of natural resources are government institutions. NGOs do make efforts, but initiatives by government institutions, including local ones, are more sustainable over the long term. For the establishment of a Transboundary Protected Area (TBPA) and implementation of any international or bilateral obligations, such as the Convention on International Trade in Endangered Species (CITES), local-level institutions that have been legitimized by national governments are important and need to be involved. It is especially important for TBPA initiatives to commence at the governmental level to formalize programmes and also, equally important to initiate the process at grassroots and the non-government level. This can be made possible if local social and political leaders take local concerns to higher levels, and NGOs can be the catalysts.

Successful participatory approaches

An increasing trend of decentralization 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 Bangladesh, Bhutan, Nepal, and Pakistan have completed the National Forestry Action Programme Framework (NFAP) and are in various stages of programme implementation, 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, Nepal and Pakistan have initiated conservation projects targeting specific endangered species.

At the regional level, the United Nations Environment Programme (UNEP), in collaboration with the South Asia Cooperative Environment Programme (SACEP) and governments in the region, has initiated the South Asian Seas Regional Programme, to promote protection of the marine environment and sound management of the South Asian seas. Following the 1998 El Niño-related rise in sea surface temperatures in the

Box 9: A Trans-boundary Protected Area in the Kanchanjungha Region of the Eastern Himalayas

Kanchanjungha Conservation Area (KCA) is situated along the trans-boundary border between Nepal, the Tibetan Autonomous Region (TAR) and Kanchanjungha Nature Reserve (KNR) in Sikkim State of India. The area jointly covers large tracts of the Himalayas to maintain species, communities, and ecological processes for the services of mankind. The Kanchanjungha Mountain Ecosystem contains one of the richest biological diversities in the eastern Himalayas. Realizing the need to protect this unique ecosystem, bordering nations (viz. India and Nepal) have declared Kanchanjungha Nature Reserve and KCA respectively as protected areas in the Kanchanjungha region.

Poor socio-economic conditions and isolated geographic location have impoverished the local communities in the Kanchanjungha region. Unaware of the potential economic values of the surrounding bio-diversity, the economic necessities have compelled the local communities to engage in illegal hunting and trading of valuable plants and animal species. The problems are exacerbated due to lack of any viable livelihood for the local people and surveillance from the concerned government authorities.



Source: Oli, K.P. 1982

Photograph: Nepali Maanish

egion and the extensive damage to coral reefs, there seems to be increased awareness and need felt in the national government 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, Maldives and Sri Lanka have initiated new programmes at the national level, in Bangladesh and Pakistan, new programmes will 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.

Biodiversity corridors

Biodiversity corridors are essential for different migratory endangered species. Certain local species are facing this threat due to rapid urbanization and humans invading forests. Wild animals attack humans and this is a source of conflict between forest enclave dwellers, fringe dwellers and animals. Another concern is the damage to crops and property. The reduced forest area and overflowing cities have left few options for these animals and they finally move into inhabited areas surrounding the forests and get killed.

Creation of Biodiversity Corridors Conservation Initiative for South Asia is a positive step in providing safe transit for migratory species. This will involve a considerable research into protected area management and transboundary and advanced GIS and spatial analysis capacity building. This would be achieved by developing corridors for migration and movement of all species of endangered species of fauna, between and along protected areas. Biodiversity corridors between and along protected areas in four countries of the region - Bangladesh, Bhutan, and Nepal - can be developed by two transboundary landscapes. One is the Himalayan Landscape along the Himalayan biodiversity hotspot, connecting protected areas through corridors in Bhutan, India and Nepal; and the second is the Coramandel Landscape, connecting protected areas with corridors along the Western Ghats biodiversity hotspot in India, with Bangladesh and ending in the Indo-Burma hotspot in North East India.

Biodiversity conservation agreements

South Asia is home to spectacular natural beauty which is approximately 15 per cent of the global biological endowments. They are however under severe threat from subsistence communities, commercial interests, alien invasive species, disasters and episodic events.

Most countries have formulated National Biodiversity Action Plans which outline threats to the biodiversity and the proposed conservation activities. Besides efforts by the governments, a large number of initiatives towards conservation of biodiversity have been taken by NGOs, Community Based Organizations (CBOs), and other institutions. However, there are still several areas in which collaborative action needs to be urgently initiated.

Formulating a South Asian Biodiversity Conservation Agreement would facilitate more detailed assessments, mapping and delineation of protected areas; revival of traditional conservation knowledge; curtailment of bio-piracy; setting up of domestic and joint venture manufacturing units; and facilitate trade in finished products rather than raw materials. While SACEP will have the primary responsibility for formulating the Agreement and coordinating follow-up action, it can take assistance from several institutions in the region, including UNEP and IUCN.

References

AIMS (2005) Status Of Coral Reefs in Tsunami Affected Countries. (ed) Clive Wilkinson, C. Australian Institute of Marine Science, 2006

Abeyegunawardene, P.D. (u.d.). *South Asian Seas: An Introduction*. South Asia Co-operative Environment Programme.

Bhutan Environment Outlook 2007, National Environment Commission

CI (2006). Conservation International. <http://www.conservation.org>

Compendium of RNR Statistics, 2008, Ministry of Agriculture, Govt. of Bhutan

FAO (2000). *Global Forest Resource Assessment 2000*. FAO Forestry Paper - 140. Food and Agriculture Organization, Rome.

FAO (2005). Global Forest Resources Assessment 2005: Progress towards sustainable forest management. FAO Forestry Paper 147. Food and Agriculture Organization of the United Nations. <http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=101&langId=1>

GRAIN and Kalpavriksh (2002). *Traditional knowledge of biodiversity in Asia-Pacific: Problems of Piracy and Protection*, GRAIN and Kalpavriksh.

Greenfacts (u.d.). <http://www.greenfacts.org/nl/biodiversiteit/1-2/1-define-biodiversity.htm#3>

IUCN (2002). *Management Guidelines for IUCN Category V Protected Areas: Protected Landscapes-seascapes*. The World Conservation Union. http://www.iucn.org/bookstore/HTML-books/BP9-management_guidelines/3.%20The%20planning.html

Ministry of Forestry and Environment (1999). *Biodiversity Conservation in Sri Lanka, A Framework of Action*. Ministry of Forestry and Environment, Sri Lanka

Oli, K.P. (1982). The Potential for a Transboundary Protected Area in the Kanchanjungha Region of the Eastern Himalayas: Protected Areas in the Governance Stream. Paper presented at *5th World Parks Congress*, 12-13 September 2003, Durban, South Africa.

Rajasuriya, A. Venkataraman, K., Muley, E.V., Zahir, H., Cattermoul, B. (2005). *Status of Coral Reefs in South Asia: Ramsar Convention (2005). List of Wetlands of International Importance*. The Bureau of the Convention on Wetlands. <http://ramsar.org/sitelist.pdf>

Bangladesh, India, Maldives, Sri Lanka. *Status of Coral Reefs of the World, 2002*. (Unknown publisher)

UNEP (2001). *State of the Environment Report of South Asia (2001)*. United Nations Environment Programme.

UNEP (2003). *Post-conflict Environmental Assessment: Afghanistan*, pp 176..United Nations Environment Programme, Geneva.

UNEP (2004). *Environmental Indicators South Asia*. United Nations Environment Programme. <http://www.rrcap.unep.org/indicator/Vertical%20South%20Asia.pdf>

UNEP (2005). *UNEP Regional Seas Programme*. United Nations Environment Programme. http://www.unep.org/regionalseas/Programmes/Non-UNEP_administered_Programmes/South_Asian_Seas/default.asp



As vast areas of forests are cleared to make room for humans, tigers are losing their natural habitat, resulting in great decline of their population.

Photograph: Karunakar Rayker



Priorities for South Asian Cooperation

Economic development and environmental quality were always thought of as independent entities; we now find them closely linked. The concept of sustainable development carries with it the premise that economic, environmental and social well beings are interrelated. It highlights the need to improve the quality of people's lives in a manner that doesn't 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 priority issues of the region are climate security, food security, water security, energy security and urbanization. These concerns have been classified on the basis of an inventory of issues followed by prioritisation. The issues are analysed under the pressure – State – Impact – Response Framework.

Climate Change



Global climate change is a natural phenomenon; it is well known that the earth's average surface temperature has been increasing since the end of the Little Ice Age. The average temperature of the earth's surface did not vary much between 1940 and 1970 AD, but a continuous rise in temperature has been recorded since 1970. The global climate system is a consequence of and link between the atmosphere, oceans, ice sheets (cryosphere), living organisms (biosphere): and soils, sediment and rocks (geosphere). Over the past few decades, human activity has significantly altered the atmospheric composition, leading to climate change of an unprecedented character (WHO/ WMO/UNEP 2003).

The most well known anthropogenic cause of global warming is Green House Gas (GHG) emissions, in recent years. Warming may induce sudden shifts in regional weather patterns like monsoons or the El Niño. Such changes would have severe consequences for water availability and flooding in tropical regions and their livelihoods

South Asian countries are particularly at risk. The impacts result not only from gradual changes in temperature and sea level rise but also, in particular, from increased climate variability and extremes, including more intense floods, droughts, and cyclones. These changes have had impacts on economic performances of South Asian countries and the lives of millions of the poor. It also puts at risk infrastructure, agriculture, human health, water resources, and the environment. South Asian nations have started to face the effects of Climate Change. All the nations of the sub-region are threatened by effects of climate change.

Glacial Lake Outburst Floods

Glacial melt will have an adverse impact on biodiversity, hydropower, industries and agriculture and make the region dangerous to live in. The disappearance of glaciers means a reduction in the mountains' natural water storage capacity, making water flows more erratic. Melting also causes lakes to form at the base of glaciers; lakes that can subsequently burst their banks as temperatures continue to rise. These are known as Glacial Lake Outburst Floods (GLOFs), which have devastating effects downstream as, even during small earthquakes, water rushes down picking up debris on the way.

The Tibetan Plateau glaciers, that are 4 km in length, are projected to disappear with a 3°C temperature rise and no change in precipitation. If current warming rates are maintained, glaciers located over Tibetan Plateau are likely to shrink at very rapid rates from 500 000 km² in 1995 to 100 000 km² by the 2030s.



The Himalayan region is particularly vulnerable to climate change

Photograph: Atif Gulzar

Table 14: Summary of Key Observed Past and Present Climate Trends and Variability in South Asia

Country	Change in temperature	Impacts
Bangladesh	An increasing trend of about 1°C in May and 0.5°C in November during the 14 year period from 1985 to 1998	Decadal rain anomalies above long term averages since 1960s
India	The updated 100 year linear trend for 1906-2005 is 0.74°C	Increase in extreme rains in north-west during summer monsoon in recent decades, lower number of rainy days along the east coast
Nepal	0.09°C per year in Himalayas and 0.04°C in Terai region, more in winter	No distinct long-term trends in precipitation records for 1948 to 1994
Pakistan	0.6 to 1.0°C rise in mean temperature in coastal areas since early 1900s	No distinct long-term trends in precipitation records for 1948 to 1994
Sri Lanka	0.016°C increase per year between 1961 to 90 over entire country, 2°C increase per year in central highlands	Increase trend in February and decrease trend in June

Source: IPCC 2007

Bhutan, India and Nepal face dangers of frequent and sudden flooding, and most importantly the threat posed by GLOFs. The large glaciers of Gangotari, Yamnotari and Go-Mukh, feeding rivers Ganga and Yamuna, have started to melt at an alarming pace. Maldives and Sri Lanka face the danger of total submergence due to rising sea levels. Certain parts of India – Andaman and Nicobar; and Lakswadeep Islands – also face a similar threat. All coastal areas will also be

Box 10: Melting Glaciers and Threat of Glacial Lake Outburst Floods

In the face of global warming, most Himalayan glaciers have been retreating at a rate that ranges from a few metres to several tens of metres per year, resulting in an increase in the number and size of glacial lakes and a concomitant increase in the threat of glacial lake outburst floods (GLOFs). Approximately 15,000 glaciers (covering an area of 33,340 sq.km), and 9000 glacial lakes throughout Bhutan, Nepal and Pakistan, as well as selected river basins in China and India were documented in a baseline study conducted earlier by ICIMOD, UNEP, and the Asia Pacific Network for Global Change Research (APN). Twenty-one GLOF events have adversely affected Nepalese territory in the recent past and to date over 200 potentially dangerous glacial lakes have been documented across the Himalayan region. These facts underline the urgent need to enhance scientific knowledge of glacier environments by continuously monitoring glaciers and glacial lakes, carrying out vulnerability assessments, implementing mitigation and adaptation mechanisms, and developing a glacial lake outburst flood (GLOF) early warning system. Regional co-operation to develop a coordinated strategy to deal with trans-boundary issues related to the impacts which can occur as a result of climate change is also required.



Photograph: Atif Gulzar

Source: ICIMOD 2007

Box 11: Preventing Catastrophies: An Early Warning System in the Lunana region, Bhutan

A manually operated early warning system was installed in the Lunana region by the Flood Warning Section (FWS) under the Department of Energy (DoE). In this system, two staff members from the FWS are stationed in the Lunana lake area and are equipped with both a wireless set and a satellite telephone. They use these to report lake water levels on a regular basis and issue warnings to downstream inhabitants, in the event of any indications of GLOFs. A number of gauges have been installed along the main river as well as at the lakes.

These are monitored at various stations at different time intervals depending on the distance from the station and base camp. The station is in regular contact with other wireless stations in the downstream areas along the Puna Tsang Chu, including the villages and towns of Punakha, Wangduephodrang, Sunkosh, Khalikhola, and Thimphu.

Source: ICIMOD 2007

affected by rising sea levels. Bangladesh has already faced salt-water intrusion and large fertile ponds have been submerged in the Bay of Bengal. Salty water has even entered ground water making the water unfit for consumption. There are numerous snow-clad mountains and glacial lakes in the northern region of Bhutan. Increases in temperature caused by global warming will result in the retreat of glaciers, increasing the volume of such lakes and ultimately resulting in GLOFs, with potentially catastrophic consequences. Glacier melt in the Himalayas is projected to increase flooding, rock avalanches from destabilized slopes, and affect water resource within the next two to three decades. This will be followed by decreased river flows as the glaciers recede.

India receives water from a few Himalayan rivers and is largely susceptible to sudden inland flooding and GLOFs. Certain measures are being taken by the Indian Government, though the extent and magnitude of these floods is still not fully known. Apart from this, India has a large coast line and increase in sea level will certainly pollute ground water thereby depleting ground water reserves.

In Nepal too, geoscientists have noted that the number and volume of GLOF hazards are growing. Some of these floods have produced discharge rates of up to 30 000 m³/sec and can run for distances of 200 km (Richardson and Reynolds 2000).

In addition, limited opportunities for safe and sustainable livelihoods in the mountains mean that population densities are growing within the river valleys where their vulnerability to GLOFs increases. The population growth means that there are now more people exposed to GLOFs and other climate-related disasters, and this is compounded by the expansion of infrastructure and settlements in the vulnerable areas.

Sea level rise

According to the IPCC Fourth Assessment Report, in coastal areas of Asia, the current rate of sea-level rise is reported to be between 1 to 3 mm/yr which is marginally greater than the global average. A rate of sea-level rise of 3.1 mm/yr has been reported over the past decade compared to 1.7 to 2.4 mm/yr over the twentieth century as a whole, which suggests that the rate of sea level rise has accelerated in relation to the long-term average.

Projected sea-level rise is very likely to result in significant losses of coastal ecosystems and a million or so people along the coasts of South Asia will likely be at risk from flooding.

A rise in temperature of between 3 and 4°C will result in hundreds of people being flooded each year. This involves serious risks and increasing pressures on coastal regions, small islands (like Maldives) and large coastal cities (like Kolkata and Mumbai).

Even under the most conservative scenarios, sea level will be about 40 cm higher than today by the end of 21st century.



Concrete ruins of a house damaged by rising sea levels on the eastern coast of Sri Lanka

Photograph: istockphoto.com

Box 12: Rising Sea Levels: Impact on Livelihoods

Sea level rise and the consequent salt water intrusion results in a change in livelihoods from agriculture to shrimp farming. In the new environment, shrimps grow by themselves and the farmers do not need much labour, thereby reducing the number of people who benefit from land. This has led the unemployed to either scavenge for wood or poach tigers. South of the shrimp farms, every additional millimeter of rising sea levels has the potential to wreak havoc on the environment as the world's largest mangrove forest - the Sundarbans, with its extensive network of tidal waterways - lies a few centimeters above the sea level. This vast and impenetrable woodland covers an estimated 17 000 square kilometers. Depending on the phase of the moon and the rainy season, the forest is either slightly submerged or transformed into a sea of mud, where small mangrove roots protrude from the soil. Here, deep in the jungle, live the last 200 Bengali Tigers - the pride of the nation – are susceptible to poaching.



Shrimp farming has reduced the amount of arable land

Photograph: istockphoto.com

Spiegel Online International 2007

The projections show that coastal populations that are flooded, annually, may increase from 13 million to 94 million. Almost 60 per cent of this increase will occur in South Asia (along coasts from Pakistan, through India, Sri Lanka and Bangladesh to Burma).

Maldives and Sri Lanka face the consequences of submergence in case of rising sea levels. Certain parts of India (Andaman and Nicobar and Lakswadeep Islands) also face a similar threat. Coastal cities and areas will also be affected by increase in sea levels. Bangladesh has already faced the effects of this increase. Large fertile ponds have now been submerged in the Bay of Bengal. Salt water has even entered into the ground water making the water unfit for most uses and has reduced the soil fertility. These large fields have been converted to shrimp farms and are an important source of income in the "salt region," as researchers, in Dhaka, now call the area.

Coastal areas inundation

Certain South Asian nations like Maldives and Sri Lanka will be most affected by rise in sea level as this would directly put a question on their existence. Maldives especially, is a very low-lying nation and hence has an increased risk. It is merely four to five feet above sea level. Other nations with large coastal lines will also be affected and these include Bangladesh, India and Pakistan. Large-scale emigration from coastal zones is expected due to submergence of coastlines, after sea levels have risen. This will create large numbers of environmental refugees especially from low-lying delta regions in poor countries. Furthermore, intrusion of sea-water in the ground water and changes in temperature can reduce agricultural and fishing incomes. Countries dependent on coastal fishery and agriculture are likely to be adversely affected.

Changing ecosystems

Ecosystems will be particularly vulnerable to climate change, with a study estimating that between 15 and 40 per cent of species face extinction, with 2°C of warming. The impact of climate change would be particularly adverse on the forests, wetlands and coastal regions

Large decreases in the natural capital of grasslands and savannas are likely, in South Asia, as a consequence of climate change.

Wetlands in South Asia are being increasingly threatened by warmer climate in recent decades. The precipitation decline and droughts in most delta regions of Bangladesh, India and Pakistan have resulted in the drying up of wetlands and severe degradation of ecosystems.

In developing regions, the remaining natural flood plains are disappearing at an accelerating rate, primarily as a result

of changes in land use and hydrological cycle, particularly changes in stream-flows due to climatic and human-related factors. According to IPCC, the most threatened flood plains will be those in South Asia.

Substantial portion of the vast mangroves in South and southeast Asian regions has been reportedly lost during the last 50 years of the 20th century, largely attributed to human activities (Zafar 2005). Evidence of the impacts of climate-related factors on mangroves remains limited to the severe destruction of mangroves due to reduction of freshwater flows and salt water intrusion, in the Indus delta and Bangladesh (IUCN, 2003a). In addition, around 30 per cent of Asia's coral reefs are likely to be lost in the next 30 years due to multiple stresses and climate change.



The duration of the monsoon is reducing and its intensity is increasing leading to destruction of ecosystems

Photograph: istockphoto.com

In Maldives, the tourism industry, which relies heavily on marine ecosystems, is also under threat from the impacts of climate change. An increase in temperature can very easily bring the reef growth and reef ecosystems to an alarmingly poor status. Although almost all the reefs have recovered from the coral bleaching event of 1997, impacts of bleaching were felt on around 90 per cent of the reefs of Maldives, either totally or partially (Naeem et al. 1998). The corals already growing at highest tolerable temperatures (approximately 30°C) have a very grim possibility of survival, given the predicted rises in temperature of 1.4 to 5.8°C for the period of 1990 to 2100 (IPCC Third Assessment Report). The islands of Maldives are reef-based and coral reefs serve as natural breakwaters. With damage to the coral reefs comes the bigger danger of losing the natural protection of the islands from the waves and currents. An island with a degraded reef is more open to coastal damages such as beach erosion and more susceptible to inundation by uncontrolled waves reaching the shore.

Climatic changes would likely exacerbate present environmental conditions that give rise to land degradation, shortfalls in food production, rural poverty and urban unrest.

Wildlife and biodiversity

South Asia is physiographically diverse and ecologically rich in natural and crop-related biodiversity. Wildlife would be affected, to a great extent, by global warming and may affect survival of some species. This may include plants, animals or even certain micro-organisms. Increased frequency of El Niño events could likely lead to measurable declines in fish larvae abundance in coastal waters. These phenomena are expected to contribute to a general decline in fishery production in the coastal waters of South Asia.

Water shortages

The water and agriculture sectors are very sensitive to climate change induced impacts in Asia. In Bangladesh, India, Nepal and Pakistan, water shortages have been attributed to rapid urbanization and industrialization, population growth and inefficient water use, which are aggravated by changing climate and its adverse impacts on demand, supply and water quality.

Over-exploitation of groundwater in many countries of Asia has resulted in a drop in its level, leading to progress of sea water in coastal areas making the sub-surface water saline. Bangladesh and India are especially susceptible to increasing salinity of their groundwater as well as surface water resources, especially along the coast, due to increases in sea level as a direct impact of global warming (Han et al. 1999).

Table 15: Rainfall Scenarios for 2010 and 2070 (% change)

Region	2010	2010	2070	2070
	Wet Season	Dry Season	Wet Season	Dry Season
SouthWest Monsoon Region India, Pakistan, Bangladesh, Philippines (western part), and Viet Nam (except east coast)	0	0	0 to 10	-10 to +10
Northeast Monsoon Region Indonesia, Philippines (east part), Viet Nam (east coast), Sri Lanka, and Malaysia	0 to -5	0	-5 to +15	0 to +10
South Asia Sub region (15-30°N; 65-95°E)	0 to +10	-5 to +5	+5 to +50	-5 to +20

Source: Whetton 1994

The gross per capita water availability in India will decline from about 1 820 m³/yr in 2001 to as low as about 1 140 m³/yr in 2050 (Gupta and Deshpande 2004). India will reach a state of water stress before 2025 when availability falls below 1 000 m³ per capita (CWC 2001). The projected decrease in the winter precipitation over the Indian subcontinent would reduce the total seasonal precipitation during December, January and February, implying lesser storage and greater water stress during the lean monsoon period. Intense rain occurring over fewer days, which implies increased frequency of floods during the monsoon, will also result in loss of the rainwater as direct runoff, resulting in reduced groundwater recharging potential. Expansion of areas under severe water stress will be one of the most pressing environmental problems in South Asia.

Water related impacts of climate change and sea level rise are likely to be some of the most critical issues for Bangladesh, as well. Climate change is predicted to increase both coastal (from sea and river water) and inland flooding (river/rain water). In addition, changes in the riverbed due to sedimentation, and changes in morphological processes, due to seasonal variation of water level and flow, will be serious. A combination of development and climate change scenarios indicates that the Lower Ganges and Surma floodplains of Bangladesh will be the most vulnerable. On the other hand, the north-central region may become flood-free, if the major rivers have embankments built - something, which has been considered under some development scenarios. The possibility of winter (dry season) drought will increase in certain areas.

Of particular concern for the Maldives is the impact of climate change on the groundwater availability. In the islands rainwater lenses lie atop salt water. As sea level rises, the thicknesses of the freshwater lens decreases, and the volume of freshwater decreases. Also sea level rise would increase the likelihood of storm over wash of the islands, causing increased incidence of saltwater contamination of the freshwater lenses.

Agriculture and fisheries



Climate change is a threat to agriculture, and therefore, food security in South Asia

Photograph: istockphoto.com

The agricultural sector is the major source of employment for all countries, in the region and will remain so in the coming decades. Change in weather and monsoon patterns will affect the agricultural sector largely. Agricultural productivity in Asia is likely to suffer severe losses because of high temperature, severe drought, flood conditions, and soil degradation.

Loss of both agricultural land and production will adversely affect people's livelihoods, especially the rural poor. Under a severe climate change scenario (a 4 degree centigrade temperature rise and increased evaporation of 22 per cent), the potential shortfall in rice production in Bangladesh could exceed 30 per cent, while that for wheat and potato could be as high as 50 and 70 per cent, respectively (Karim 1996).

Even under a moderate climate change scenario, the crop loss due to salinity intrusion could be 0.2 m annually (Habibullah et al. 1999). The anticipated drop in agricultural production, when coupled with losses in other sectors, will have a deep impact on the development prospects for South Asian countries, severely threatening food security. The ultimate impact of loss of food grain production would be an increase in food imports.

Production of rice, maize and wheat in the past few decades has declined in many parts of Asia due to increasing water stress arising partly from increasing temperature, increasing frequency of El Niño and reduction in the number of rainy days. In a study at the International Rice Research Institute, the yield of rice was observed to decrease by 10 per cent for every 1°C increase in growing-season minimum temperature (Peng et al. 2004).



The environment around agriculture in South Asia has drastically changed

Photograph: istockphoto.com

As land for agriculture becomes limited, the need for more food in South Asia could probably be met by increasing yields per unit – of land, water, energy and time – through precision farming. Enhanced variability in hydrological characteristics will, most likely, continue to affect grain supplies and food security. Intensification of agriculture will be the most obvious means to meet the food requirements, which is likely to be invariably affected by projected climate change. It is projected that crop yields could decrease up to 30% in South Asia by the mid-21st Century.

However, increasing urbanization and population will result in increased food demand and reduced supply due to limited availability of cropland area and yield declines projected, in most cases (Murdiyarso 2000; Wang 2002; Lin et al. 2004). Food supply or ability to purchase food directly depends on income and price of the products. The global cereal prices have been projected to increase more than three-fold by the 2080s as a consequence of decline in net productivity due to projected climate change (Parry et al. 2004).

Nepal has a high dependency on agriculture and over 80 per cent of water, in the country, is used for irrigation. Higher temperatures, increased evapo-transpiration and decreased winter precipitation may bring about more droughts. Studies in South West Asia show that decreased winter snowfall on glaciers does indeed decrease the spring/summer runoff. This has already caused severe droughts in Pakistan, in areas that depend on water from mountain sources (Subbiah 2001). A similar pattern would severely affect irrigation and farming livelihoods in Nepal. The land that can be cultivated varies by location and season, since the vast majority of surface water irrigation systems in Nepal depend on the water flowing at its source (USCSP 1997). In some cases, the winter cropping area is only 20 per cent of the cultivable area during the summer.

Some predict some positive impacts on agriculture from climate change and its causes, such as increased temperatures and higher carbon dioxide levels. While these may have positive impacts on crop yields, this is only where moisture is not a constraint. For example, the apparent increase in Boro yield, in Bangladesh, as a result of increased carbon dioxide would be constrained by moisture stress. A 60 per cent moisture stress, apart from other effects, might cause as high as a 32 per cent decline in Boro yield, instead of an overall 20 per cent net increase (Karim et al. 1999). It is feared that moisture stress would be more intense during the dry season, which might force Bangladeshi farmers to reduce the area for Boro cultivation. Warmer temperatures may also increase the occurrence of extreme events or pests, offsetting any potential benefits. Both crops and livestock would be affected by an increase in disease or alien/invasive pests. An increase in temperature, despite reduction in humidity, can reduce the ability of farmers to work. As a result, low-income rural populations that depend on traditional agricultural systems or on marginal lands are particularly vulnerable to climate change and livelihoods will be at risk. Agriculture presently contributes 25 per cent

to Pakistan's national income; provides employment to 50 per cent of the labour force; and 60 per cent of the country's exports are directly or indirectly based on agriculture. In the medium GDP growth scenario, agriculture's share in national income is projected to fall to 20 per cent by the year 2020 and further to about 15 per cent by the year 2050. For a developing country, these are very large changes, which can cause much human misery. In India, a 2°C increase would be clearly intolerable. Other developing countries may be even more vulnerable, especially Bangladesh and Small Island States.

An interesting aspect is that agriculture, itself, is responsible for emitting methane, which is 24 times more effective than CO₂ in causing global warming.

Fishery is also expected to suffer from the impacts of climate change. Tuna fishery is the main fishery in Maldives and tuna is a migratory species. A possible change in temperatures can drive tuna stock to more favourable temperatures. This can lead to a decline in the fisheries industry as the fishermen lose their fishing grounds. The tuna fishery is based on the pole and line method using bait fish. Any changes to the availability of bait fish caused by damage to the reefs would also affect the tuna fishery.

Natural disasters

The number of cyclones originating from the Bay of Bengal and Arabian Sea, have been noted to decrease, since 1970, but their intensity has increased (Lal 2001). An increase of 10 to 20 per cent in tropical cyclone intensity for a rise in sea-surface temperature of between 2 and 4°C, relative to the current threshold temperature, is likewise projected in South Asia (Knutson and Tuleya 2004). Amplification in storm-surge heights could result from the occurrence of stronger winds, with increase in sea-surface temperatures and low pressures, associated with tropical storms, resulting in an enhanced risk of coastal disasters along the coastal regions of countries.

Increasing trends in climate-induced disasters in South Asia have added to overall damage in the region. Windstorms and cold and heat waves affected the region during the last year; in 2005 windstorms in Afghanistan, Bangladesh, India and Pakistan resulted in 519 deaths, 1 796 injured and 124 656 people were reported to be affected. In South Asia, after earthquake and floods, windstorms affect the largest numbers of people.

Cold and heat waves are also emerging as severe risks for certain social groups in South Asia. For instance, 715 deaths were reported last year due to cold and heat waves affecting Bangladesh, India and Pakistan. An onslaught of snow and avalanches took thousand lives across Afghanistan, India and Pakistan.

In Pakistan, officials report that more than 530 people died in northern and southern areas due to heavy snowfall and rain. In Afghanistan, at least 267 deaths were reported due to avalanches.

Elaborating the relationship between climate change and disasters, a report by the International Institute of Sustainable Development (IISD) states: *"The poor are already vulnerable to climate risks. Settlement on marginal or unstable lands such as steep slopes or floodplains heightens their exposure to the impacts of climate hazards. Heavy dependence on ecosystem services can place their welfare and survival at the mercy of environmental conditions. As the availability and quality of natural resources decline due to natural and human-induced pressures, so does the viability and*

Box 13: Launch of National Disaster Information System

Natural Disasters Information System (NDIS), a unique warning solution, will be integrated with the tsunami's early warning system, which will become operational by September 2007 in India. The system, first of its kind in the world, alerts people in the area in their local language through SMS, voice and wireless public address systems within a minute. Chennai and Nagapattinam, the worst affected by tsunami, have been chosen as pilot sites for sending warning messages. The NDIS will help people move towards safe zones, thereby reducing damage to life and property.

Source: *The Hindu* 2006

security of their livelihoods. With limited capacities and resources at their disposal to respond to stresses such as droughts and floods, their ability to meet basic needs and move out of poverty is constrained. Climate change, therefore, threatens to exacerbate existing vulnerabilities and further entrench development disparities. Those with the least, stand to suffer the most. Thus, with regional changes and impacts already being observed, the need for adaptive response measures is imperative. For the poor and other vulnerable people, the need is urgent."

Policies and interventions aimed at increasing adaptive capacities of vulnerable communities towards climate change are missing in current disaster management thinking. Although South Asian governments are signatories to most of the climate related treaties, declarations and protocols, commitments are yet to be translated into reality.

Impact on wellbeing

The impacts of climate change are likely to be detrimental to the health of the population, mainly through heat stress and possible increases in vector-borne (dengue fever and malaria) and water-borne diseases. Decreases in water availability and food production - especially if there is a shortage of water for irrigation – would indirectly affect the health of the population. Infant mortality rates and the prevalence of infectious diseases also are considered to be indicators of human health (WRI 1996).

Climate change will have direct impacts, through heat stress, as well as indirect effects, through reductions in food, leading to poor nutrition and increased susceptibility to diseases. The overall impact of climate change on human societies can vary, depending on multiple factors such as the amount of low-lying or arid land they occupy and their

Box 14: Consequences in the Future

- ❖ Glacier melting in the Himalayas is projected to increase flooding and will affect water resources within the next two to three decades.
- ❖ Climate change will compound the pressures on natural resources and the environment due to rapid urbanization, industrialization, and economic development.
- ❖ Crop yields could decrease up to 30 per cent in South Asia by the mid-21st century.
- ❖ Mortality due to diarrhoea primarily associated with floods and droughts will rise in South Asia.
- ❖ Sea-level rise will exacerbate inundation, storm surge, erosion and other coastal hazards.
- ❖ The consequences of such environmental changes include:
 - ❖ Decreased water availability and water quality in many arid and semiarid regions
 - ❖ An increased risk of floods and droughts in many regions
 - ❖ Reduction in water regulation in mountain habitats
 - ❖ Decreases in reliability of hydropower and biomass production
 - ❖ Increased incidence of waterborne diseases such as malaria, dengue, and cholera
 - ❖ Increased damages and deaths caused by extreme weather events
 - ❖ Decreased agricultural productivity
 - ❖ Adverse impacts on fisheries
 - ❖ Adverse effects on many ecological systems

As a result of these changes, climate change could hamper the achievement of many of the Millennium Development Goals (MDGs), including those on poverty eradication, child mortality, malaria, and other diseases, and environmental sustainability.

Much of this damage would come in the form of severe economic shocks. In addition, the impacts of climate change will exacerbate existing social and environmental problems and lead to migration within and across national borders. In sum, climate change is clearly not just an environmental issue but one with severe socio-economic implications in South Asia.

Source: World Bank 2007

degree of dependence on agriculture or aquatic resources. In some areas, especially where access to safe drinking water is poor, water-borne gastrointestinal diseases related to fecal contamination such as giardiasis, diarrhoea is a problem. Such diseases contribute to high infant mortality rates, as is the case in Afghanistan and Pakistan (Azim and Rahaman 1993; Nazer et al. 1993; Chavasse et al. 1996).

Climate change poses substantial risks to human health in South Asia. Global burden (mortality and morbidity) of climate-change attributable diarrhoea and malnutrition were already the largest in Bangladesh, Bhutan, India, Maldives and Nepal in 2000, and the relative risks for these conditions for 2030 is expected to also be the largest (McMichael et al., 2004), although in some areas, such as the southern states in India, there will be a reduction in the transmission season by 2080 (Mitra et al. 2004).

Some countries of the region have made efforts to control these diseases through various programs from the early seventies. If flooding occurs, as a result, of more intense rainfall events, water-borne diseases may become frequent, mostly due to overloading of sewage systems (McMichael 1997).

A large number of deaths due to heat waves – mainly among the poor, elderly and labourers such as rural daily wage earners, agricultural workers and rickshaw pullers – have been reported in the Indian states, especially Andhra Pradesh and Orissa, during the past five years (Lal 2002). Increase in coastal water temperatures would exacerbate the abundance and / or toxicity of cholera in South Asia.

The poor, particularly in urban and urbanising cities of Asia, are highly vulnerable to climate change because of their limited access to profitable livelihood opportunities and limited access to areas that are fit for safe and healthy habitation. Consequently, the poor sector will likely be exposed to more risks from floods and other climate-related hazards in areas they are forced to stay in (Adger 2003).

Measures to address climate change

A major concern in South Asia is the lack of knowledge and awareness on climate change as well as the lack of necessary resources to assess the possible impacts. There is a need for research on localized climate changes and its impacts. Climate Action Network South Asia (CANSAs) has been actively involved in climate negotiations. It needs to be strengthened and encouraged.

Adaptation

Agriculture and food security

Adaptive capacity can be increased by modifying farming practices, improving crops and livestock through breeding and investing in new technologies and infrastructure. Specific examples include adaptation of grassland management to actual environmental conditions, as well as the practice of reasonable rotational grazing to ensure sustainability; improvement of irrigation systems; breeding new rice varieties to minimize the serious productivity losses; and information, education and communication programmes to enhance the level of awareness and understanding of the vulnerable groups.

Changes in management philosophies could also enhance adaptive capacity. The adaptive capacity of poor subsistence farming and herding communities is low in many developing South Asian countries. One of the important and effective measures to enhance their adaptive capacity is through education and the provision of easy access to climate change-related information.



Indirect impacts of climate change include health risks to children from economically poor families

Photograph: istockphoto.com

Water resources

There are many adaptation measures that could be applied in various parts of South Asia to minimize the impacts of climate change on water resources and use; and several of these address the existing inefficiency in water use. Modernisation of existing irrigation schemes and demand management aimed at optimizing physical and economic efficiency, in the use of water resources and recycled water, in water stressed countries of South Asia, could be useful in many agricultural areas, particularly in arid and semi-arid countries. Public investment policies that are aimed at improving access to available water resources, integrated water management, respect for the environment and promotion of better practices for wise use of water in agriculture, including recycled waste water, could potentially enhance adaptive capacity.

As an adaptation measure, apart from meeting non-potable water demands, recycled water can be used for recharging groundwater aquifers and augmenting surface water reservoirs. Recycled water can also be used to create or enhance wetlands and riparian habitats. While water recycling is a sustainable approach towards adaptation to climate change and can be cost-effective in the long term, the treatment of wastewater for reuse, such as is being practised now in Singapore, and the installation of distribution systems, can be initially expensive compared to such water supply alternatives as imported water or groundwater, but are potentially important adaptive options in many countries of South Asia. Reduction of water wastage and leakages address the decrease in water supply due to decline in precipitation and increase in temperature. The use of market-oriented approaches to reduce wasteful water uses could also be effective in reducing effects of climate change on water resources (Ragab and Prudhomme 2002).

Conversion of cropland to forest (grassland); restoration and re-establishment of vegetation; improvement of tree and herb varieties; and selection and cultivation of new drought-resistant varieties, wherever possible, are effective measures to prevent water scarcity due to climate change. Water saving schemes for irrigation can be enforced to avert water scarcity in regions already under water stress.

Coastal and low lying areas

The response to sea-level rise could mean protection, accommodation and retreat. As substantial socio-economic activities and populations are currently highly concentrated in the coastal zones in South Asia, protection should remain a key focus area.

Box 15: National Action Plan on Climate Change

India released its National Action Plan on Climate Change (NAPCC) on 30th June 2008 to outline its strategy to meet the challenge of Climate Change. The National Action Plan advocates a strategy that promotes, firstly, the adaptation to Climate Change and secondly, further enhancement of the ecological sustainability of India's development path. India's National Action Plan stresses that maintaining a high growth rate is essential for increasing living standards of the vast majority of people of India and reducing their vulnerability of the impacts of climate change. Eight National Missions which form the core of the National Action Plan represent multi-prolonged, long term and integrate strategies for achieving key goals in the context of climate change.

National Missions

1. The National Solar Mission
2. The National Mission on Enhanced Energy Efficiency
3. The National Mission on Sustainable Habitat
4. The National Water Mission
5. The National Mission for sustaining the Himalayan Ecosystem
6. The National Mission for a Green India
7. The National Mission for Sustainable Agriculture
8. The National Mission on Strategic Knowledge for Climate Change

Source: National Action Plan on Climate Change, MoEF, 2008

Integrated Coastal Zone Management (ICZM) provides an effective coastal protection strategy to maximise the benefits provided by the coastal zone and to minimise the conflicts and harmful effects of activities on social, cultural and environmental resources to promote sustainable management of coastal zones (World Bank, 2002). The ICZM concept is being embraced as a central organising concept in the management of fisheries, coral reefs, pollution, megacities and individual coastal systems in India and Sri Lanka. The ICZM concept and principle could potentially promote sustainable coastal area protection and management in South Asia.

Natural ecosystems and biodiversity

Climate change can have adverse effects on forests in South Asia. Improved technologies for tree plantation development and reforestation could likely enhance adaptation especially in vulnerable areas. Likewise improvement of protection from fires, insects and diseases could reduce vulnerability of most forests due to climate change and variability.

Comprehensive inter-sectoral programmes that combine measures to control deforestation and forest degradation, with measures to increase agricultural productivity and sustainability, will contribute more to reducing vulnerability of forests to climate change, land use change and other stress factors than independent sectoral initiatives. Other effective adaptation measures to reduce the impacts of climate change on forest ecosystems include extending rotation cycles, reducing damage to remaining trees, reducing logging waste, implementing soil conservation practices and using wood in a more carbon-efficient manner so that a large fraction of their carbon is conserved.

Natural resources utilization could intensify in several parts of South Asia in response to increasing demands. To sustain development in this region, measures to minimise deforestation and enhance restoration of degraded forests will be required. The challenge in South Asia to reduce the perturbations of the ecosystems and the environment that could be aggravated by climate change, in countries with developing economies geared to maximize production. In the same manner, the use of water will continue to increase as the population and economies of countries grow. This is likely to put more stress on water that could be exacerbated by climate change. Integrated responses to cope with the impacts of climate change and other stressors on the supply and demand side will likely contribute in the attainment of sustainable development in South Asia.

Human health

Assessment of the impacts of climate change is the first step for exploring adaptation strategy. A disease monitoring system is as essential as the basic data source. Specifically, the monitoring of diseases along with related ecological factors is required. Disease monitoring is necessary in assessing the effectiveness and efficiency of the adaptation measures. For effective adaptation measures, the potential impacts of climate variability and change on human health need to be identified, along with barriers to successful adaptation and the means of overcoming such barriers.

Implementation of heat watch and warning systems and other similar monitoring systems, in other parts of Asia, will help in reducing the impacts of climate change on human health.

Key constraints to adaptation measures

Effective adaptation and adaptive capacity in Asia, particularly in South Asia, will continue to be limited by several ecological, social and economic, technical and political constraints; and spatial and temporal uncertainties associated with forecasts of regional climate, low level of awareness among decision makers of the local and regional impacts of El Niño, limited national capacities in climate monitoring and forecasting, and lack of coordination in the formulation of responses.

Impacts of climate change may occur beyond certain thresholds in the ability of some ecosystems to adapt without dramatic changes in their functions and resilience. The inherent sensitivity of some ecosystems, habitats and even species with extremely narrow ranges of bio-geographic adaptability will also limit the options and effectiveness of adaptation.

Poverty

Poverty is identified as one of the greatest barriers to developing the capacity to cope and the poor, usually, have a very low adaptive capacity due to their limited access to information, technology and other capital assets, which make them highly vulnerable to climate change. Poverty also constrains adaptation in other sectors. Poverty, along with infrastructural limitations and other socio-economic factors, could also limit efforts to conserve biodiversity in South Asia. Adaptive capacity in countries where there is a high incidence of poverty will likely remain limited.

Inadequate awareness

Insufficient information and knowledge on the impacts of climate change and responses of natural systems to climate change will continue to hinder effective adaptation particularly in South Asia. The limited studies on the interconnections between adaptation and mitigation options, costs and benefits of adaptation, and trade-offs between various courses of actions will also likely limit adaptation initiatives. The deficiency in available information and knowledge will continue to make it difficult to enhance public perception of the risks and dangers associated with climate change. In addition, the absence of information on adaptation costs and benefits makes it difficult to identify the best adaptation option. This limiting factor will be most constraining in developing countries, where systems for monitoring and research on climate, and responses of natural and human systems to climate are usually lacking.

Lack of political motivation

The slow change in the political and institutional landscape in response to climate change could also be a major limitation to future adaptation. The existing legal and institutional framework in most South Asian countries remains inadequate to facilitate implementation of comprehensive and integrated response to climate change in synergy with the pursuit of sectoral development goals.

Mitigation

If countries recognize the environmental, societal and ecosystem benefits of mitigation and value them properly, it would justify incurring large mitigation costs. There is a need to elaborate an approach to mitigate the threat of climate change, which is equitable and can accommodate differing perspectives on risk. To initiate action, with differing perspectives of uncertainties and risks that different countries have, a global trading system for carbon emissions with a futures market can be introduced. The allocations of quotas can be made on an equitable basis, however, the total quota will depend upon each country's subjective trajectory that restricts global temperature change to a desired limit; for example, 2°C. Countries, however, are responsible for their cumulative emissions in carbon-ton-years that they have made and the range of permissible trajectories narrows as our knowledge and understanding improve.

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 carbon emission reduction. The South Asian region can look at how these mechanisms may can be utilized for the benefit of the region as a whole and 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 forums. Finally, it may facilitate the flow of funds for mitigating or adapting to the adverse impacts of climate change.

Climate friendly initiatives

Cleaner and more efficient transport

This will include substitution of conventional fuels with bio-fuels. These bio-fuels are a mixture of bio-diesel and ethanol. Jatropha oil is used as bio-diesel and can be grown in arid soils also. Certain ambitious projects like National

Highway Development Projects are also very promising in the near future. This will help reduce driving conditions drastically and reduce traffic congestion. Better transport facilities like Metro Rails would encourage usage of public transport and also, help reduce CO₂ emissions.

Climate friendly policy reforms

These include implementing measures to reduce emissions in different categories of industry. It would include price regulation by the governments by providing subsidies for less polluting fuels and projects and increasing prices of the more polluting fuels and projects. Governments should also encourage more Clean Development Mechanism (CDM) projects and research on better technologies like CO₂ capture and storage. Under the recent economic liberalisation policy of the Government, the private sector, both domestic and foreign, is seeking entry into the energy supply sector - coal, oil, gas or electricity.

There is also a need for a policy on population in South Asia. In the sub region, populations are very high and population control and family welfare policies can indirectly contribute to GHGs' abatement. In India, the population policy has resulted in reducing births by 40 million in the last three decades thereby resulting in reduced carbon emissions

Sink projects through forestation and wasteland development

It is generally believed that the sink projects such as growing trees for afforestation are some of the most attractive options.

- a) The trees fix carbon only during the growing periods. After reaching maturity, they are carbon neutral. Thus, carbon sink projects can create liabilities for the host country through committed land use.
- b) If mature forests are removed, it may appear in the statistics of land use change, though wood is burnt will generate carbon dioxide emissions.
- c) If forests are left intact, it may have implications in terms of the making opportunity cost of land high. However, a country needs to take a careful long-term decision to create green cover on a permanent basis, before considering such projects.
- d) Another difficulty relates to the measurement of carbon sequestered. This is not an easy task. Forestation projects involve very little technology and hence very little technology transfer.

Technology transfer and the Clean Development Mechanism

Technology transfer is claimed to be a major advantage of the Clean Development Mechanism (CDM). Technology transfer and CDM should be linked to ensure wider adoption of environmentally beneficial technologies beyond the CDM project. South Asia requires CDM projects, which lead to real technology transfer giving countries the ability not only to operate the technology but also to replicate and innovate. Another concern is pricing of technology and competition in this arena will reduce costs. In most bilateral trade, the supplier of technology has a monopoly and the price charged for technology may be too high.

Equitable climate

An equitable climate regime will focus on limiting the risks from climate change impacts to poor developing countries rather than on limiting the costs of mitigation. Options that improve economic efficiency of mitigation also need to address the distribution of economic costs associated with climate change. Such a system needs to be guided by a better understanding of the potential economic impacts and other risk to developing countries which emanate from the climate change problem. One must also recognize the need for economic growth of developing countries.

References

- Adger, N. (2003). Social Capital, Collective Action, and Adaptation to Climate Change. *Econ. Geog.*, (79), 387-404.
- Agrawala, S., Raksakulthai, V., van Aalst, M., Larsen, P., Smith and Reynolds, J. (u.d.). *Development and change in Nepal: Focus on Water Resources and Hydropower*

Alpan-Atamer, S. Med-Consult, Turkey

Azim, S.M.T. and Rahaman, M.M. (1993). Home management of childhood diarrhoea in rural Afghanistan - a study in Urgun, Paktika province. *Journal of Diarrhoeal Diseases Research*, 11, 161-164.

Bajracharya, S.R., Mool, P.K. and Shrestha, B.R. Facing Climate Change In South Asia. In *Case Studies on GLOFs and Associated Hazards in Bhutan and Nepal*. International Centre for Integrated Mountain Development.

CAN (u.d.). *Climate Change Reports and FAQs*. Climate Action Network South Asia

Chandler, W. (u.d.). *Climate Change Mitigation in Developing Countries*. Battelle Memorial Institute

Chavasse, D., Ahmad, N. and T. Akhtar (1996). Scope for fly control as a diarrhoea intervention in Pakistan - a community perspective. *Social Science and Medicine*, 43, 1289-1294.

Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, Li, C. and Ninh, N. H. (2007). Asia. *ClimateChange 2007: Impacts, Adaptation and Vulnerability*. In *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Eds.) M.L. Parry,

CWC (2001) . *Water and Related Statistics*. Report of the Ministry of Water Resources. CentralWater Commission. New Delhi.

Garg, A. (1995). India's Approach to Climate Change Mitigation. In *Second Assessment Report of the Intergovernmental Panel on Climate Change*. Intergovernmental Panel on Climate Change.

Garg, A.(2001). India's Approach to Climate Change Mitigation. In *Third Assessment Report of the Intergovernmental Panel on Climate Change*. Intergovernmental Panel on Climate Change.

Gupta, S.K. and Deshpande, R.D. (2004). Water for India in 2050: First-order Assessment of Available Options. *Curr. Sci. India*, 86, 1216-1224.

Habibullah, M., Ahmed, AU. and Karim, Z. (1999). Assessment of food grain production loss due to climate induced soil salinity: a case study. In: S. Huq, Z. Karim, M. Asaduzzaman and F. Mahtab (Eds.) *Vulnerability and Adaptation to Climate Change for Bangladesh*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Han, M., Zhao, M.H., Li, D.G. and Cao, X.Y. (1999). Relationship between Ancient Channel and Seawater Intrusion in the South Coastal Plain of the Laizhou Bay. *Journal of Natural Disasters* 8, 73-80.

The Hindu (2006). <http://www.hindu.com/2006/02/14/stories/2006021401920400.htm>

ICIMOD (2007). *Impact of Climate Change on Himalayan Glaciers and Glacial Lakes; Case Studies on GLOF and Associated Hazards in Nepal and Bhutan*. International Centre for Integrated Mountain Development (ICIMOD) in cooperation with United Nations Environment Programme Regional Office Asia and the Pacific (UNEP/ROAP) Kathmandu, Nepal June 2007

IUCN (2003a) *Indus Delta, Pakistan: Economic Costs of Reduction in Freshwater Flows. Case Studies in Wetland Valuation No. 5*. The World Conservation Union, Karachi, 6 pp. <http://www.waterandnature.org/econ/CaseStudy05Indus.pdf>. (Accessed 24.01.07)

Karim, Z., (1996). Agricultural vulnerability and poverty alleviation in Bangladesh. In: TE. Downing (Ed.) *Climate Change and World Food Security*. NATO ASI Series, 137. Springer-Verlag, Berlin, Hiedelberg.

Karim, Z. Sk Ghulam, H. and Ahsan, A. U. (1999). Climate Change Vulnerability of Crop Agriculture. In *Vulnerability and Adaptation to Climate Change for Bangladesh*. S. Huq, Z. Karim, M. Asaduzzaman and F. Mahtab (Eds.) . Kluwer Academic Publishers, Dordrecht, The Netherlands.

Nazer, H., Aljobe, I., H. Qubain, and Latif, D.A., (1993). Diarrhoea - a continuing health problem in Jordanian infants. *Journal of Tropical Pediatrics*, 39, 195-196.

Khan, S. R. (u.d.) *Does Climate Change Matter in Pakistan?* The World Conservation Union. <http://www.iucn.org/themes/ceesp/publications/art-mono/life.doc>

Knutson, T.R. and Tuleya, R.E. (2004). Impacts of CO₂ Induced Warming on Simulated Hurricane Intensities and Precipitation: Sensitivity to the Choice of Climate Model and Convective Parameterization. *J. Climate* 17, 3477-3495.

Ministry of Environment and Construction (2002). *Government of Maldives*

- Ministry of Environment and Construction (2004). *State of Environment 2004. Government of Maldives*
- MoEF (u.d.). *Climate Change and India: Adaptation issues and concerns: Brief Overview*. Ministry of Environment and Forests, Government of India
- Lal, M. (2001). Tropical cyclones in a warmer world. *Curr. Sci. India* 80, 1103- 1104.
- Lal, M. (2002). Global Climate Change: India's Monsoon and its Variability. *Final Report under Country Studies Vulnerability and Adaptation*. Work Assignment with Stratus Consulting's Contract of the U.S. Environmental Protection Agency, 58 pp.
- McMichael, A.J., Campbell-Lendrum, D., Kovats, S., Edwards, S., Wilkinson, P., Wilson, T. Nicholls, R. and Co-authors (2004). Global Climate Change. Comparative Quantification of Health Risks: Global and Regional Burden of Disease due to Selected Major Risk Factors. (Eds. M. Ezzati, A. Lopez, A. Rodgers and C. Murray) pp 1543-1649. World Health Organization, Geneva,
- Mitra, A., Bhattacharya, S., Dhiman, R.C., Kumar K.K. and Sharma, C. (2004). Impact of Climate Change on Health: a Case Study of Malaria in India. In *Climate Change and India: Vulnerability Assessment and Adaptation* (Eds. P.R. Shukla, S.K. Sharma, N.H. Ravindranath, A. Garg and S. Bhattacharya) pp 360-388. Orient Longman Private Limited, Hyderabad.
- Murdiyoso, D. and Adiningsih, E. (2006). Climatic Anomalies, Indonesian Vegetation Fires and Terrestrial Carbon Emissions. In *Mitigation and Adaptation Strategies for Global Change* 12, 101-112.
- Naeem, I., Rasheed, A., Zuhair, M & Riyaz, M. (1998). Coral bleaching in the Maldives –1998. Survey carried out in the North and South Malé atolls. *Climate Change and Human Health*, WHO/WMO/UNEP.
- O.F. Canziani, J.P. Palutikof, P.J., van der Linden and C.E. Hanson, pp 469-506. Cambridge University Press, Cambridge, UK.
- Parikh, J.K., and Kirit Parikh (u.d.). *Climate Change: India's Perceptions, Positions, Policies and Possibilities*. Indira Gandhi Institute of Development Research
- Parry, M.L., C. Rosenzweig, A., Iglesias, Livermore M. and G. Fischer (2004). Effects of climate change on global food production under SRES emissions and socio-economic scenarios. *Global Environ. Chang.*, 14, 53-67.
- Peng, S., J. Huang, J.E. Sheehy, R.E. Laza, R.M. Visperas, X. Zhong, G.S. Centeno, G.S. Khush and K.G. Cassman, 2004: *Rice Yields Decline with Higher Night Temperature from Global Warming*. 101, 9971-9975. P. Natl. Acad. Sci. USA.
- Pew Climate Centre
- Ragab, R. and Prudhomme, C. (2002). Climate Change and Water Resources Management in arid and semi-arid regions: prospective and challenges for the 21st century. *Biosystems Engineering*, 81, 3-34.
- Richardson, S. and J. Reynolds, 2000. An overview of glacial hazards in the Himalayas. In *Quaternary International* 65/66 (2000): 31-47 Schaeffer, R. (u.d.). Federal University of Rio de Janeiro
- Shobhakar D. (u.d.). *Climate Change Initiatives and Nepal*. Institute for Global Environmental Strategies
- Spiegel Online International (2007). Struggling to adapt in Bangladesh: The Salty Taste of Global Warming. <http://www.spiegel.de/international/world/0,1518,480847-2,00.html>
- Pictorial Printers (2006). *Tackling the Tides and Tremors: South Asia Disaster Report 2005*
- The Economics of Climate Change. Stern Review.
- UNESCO (u.d.). *UNESCO Report on Campaign to Everest (Protection of World Heritages)*. United Nations Educational and Scientific Organisation.
- World Bank (2007). *South Asia and Climate Change: A Development and Environmental Issue*. The World Bank. <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/,,menuPK:2246552~pagePK:146754~piPK:146824~theSitePK:223547,00.html>
- Whetton P. (1994). Constructing Climate Scenarios: The Practice. In *Climate Impact Assessment Methods for Asia and Pacific*, Jakeman A J, Pittock A B (eds).
- Zafar, A., (2005). Training and capacity building for managing our mangroves resources- UNU's role to meet regional challenges. Environment and Sustainable Development Programme, Tokyo, Japan. Technical Notes of United Nations University, 5 pp. http://www.inweh.unu.edu/inweh/Training/UNU_Mangroves_course.pdf.
- Zolotov, P.A. and Caliberny, (2004). Human Physiological Functions and Public Health Ultra-Continental Climate. *Proc. Intl. Conf. on Climate Change and Public Health in Russia*, N.F. Izmerov, B.A. Revich and E.I. Korenberg, Eds., Russian Academy of Sciences, Moscow.

Food Security



Food security is among the most pressing challenges faced by South Asia. It is of prime importance in the present day scenario, in view the high rate of population growth, high concentration of poor households and low per capita income, in spite of a reasonable rate of GDP growth prevalent in the countries of South Asia.

For meeting food security needs, it is imperative to identify various factors that hinder the appropriate implementation of policies and programs that aim at increasing food access. In order to understand the challenges that countries in the South Asian region face in achieving food security, it is important to review the current status of food production in the region. Evaluating past solutions in the region for their impact is important to refine and redefine appropriate approaches for food security interventions.

The role of agriculture

In South Asia, 430 million people live on less than US\$1.00 per day (World Bank 2005). South Asia, with its GNI per capita at US\$594 in 2004, is home to 47 per cent of the worlds poor. Most of the poor in South Asia are dependent on agriculture for their livelihood and survival. Approximately, 60 per cent of the labour force is involved in agriculture and the sector accounts for 23 per cent of GDP (IFPRI).

Economic reforms

The national food security status of South Asian countries also reveals a positive trend. The countries have transformed themselves from food deficit countries in the 1960s and 1970s to food surplus countries in the 1980s and 1990s. However, increased food production has not been fully translated in terms of household and individual food security.



Paddy is the dominant food crop in South Asia

Photograph: istockphoto.com

This is partly due to a high level of poverty that coexists with nutritional and food insecurity. Furthermore, malnutrition remains a challenge even in urban areas, where there has been a relative increase in income among the households. Higher prices paid to farmers for their produce have been partly responsible for a growth in the food grain reserves at the national level. Lower food prices have increased accessibility to food and enhanced the prospects for exports of food. Yet, food insecurity continues to be a major development challenge because of the low purchasing power of the majority of the population which is below the poverty line. Economic reforms and market liberalization in the food and agriculture sector in South Asia have spurred



The private sector imported food to prevent starvation after severe floods in Bangladesh

Photograph: Vivek Chugh

private investments in high value agriculture such as fruits, vegetables, livestock and fisheries. However, it is not clear whether investments in high value crops will result in reducing food insecurity of the vulnerable sections of the population.

Opening up food markets for the private sector

The emerging trends in food security intervention policies and programmes show that there has been increased privatization of food markets in South Asia. A case in point is Bangladesh. When the country was affected by severe floods in 1998, The Economist predicted that the country faced starvation and the death of about 20 million people, due to floods, which wiped out more than two thirds of the country's rice crop. Yet, Bangladesh did not have a single death due to starvation as its private sector was developed to deal with food shortages. Bangladesh's private sector imported adequate amounts of food from India and other countries in the region to meet the deficits caused by the floods. Along with food aid, the private

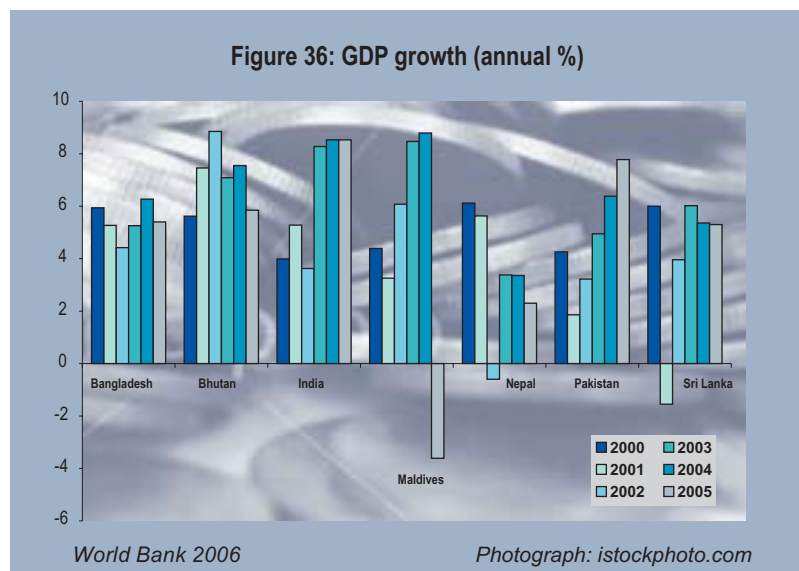
sector helped in preventing starvation and death in Bangladesh. This example shows that liberalizing local markets and encouraging private sector participation will help in preventing starvation and death due to national disasters (Dorosh, et al. 2004).

Reducing subsidies

There has been a considerable reduction in food subsidies in the countries of South Asia. Pakistan's experience in abolishing its wheat rationing system in the 1980s and allowing private traders to participate in food trade presents a stark contrast to the Indian system of maintaining a huge level of subsidies through the food distribution system to protect its vulnerable population (Islam and Garrett 1997). There is also a diminishing role of the public sector participation in food distribution, particularly in countries like Pakistan and Bangladesh. There has been a shift from broad based public distribution system towards target interventions through social safety nets in the region (Babu 2003).

Prosperity across the region

A positive picture of the rate of economic growth in South Asian countries during the years 2000-2005 can be seen from figure 36. With the exception of Nepal, all countries in the region have experienced a growth rate of more than four per cent over the last five years. Maldives, on the other hand, has shown a negative growth rate for the year 2005 (due to the tsunami), whereas India has crossed the 8 per cent growth mark. Such increased growth in the national income should lend



itself to improved food security for the population as this will contribute to a continuing shift out of agricultural occupations into industry and services, and out of rural and marginal areas into urban centres. This will leave fewer countries who are unable to pay for food imports, and fewer people vulnerable to local decline in food production.

Agriculture: a major source of livelihoods

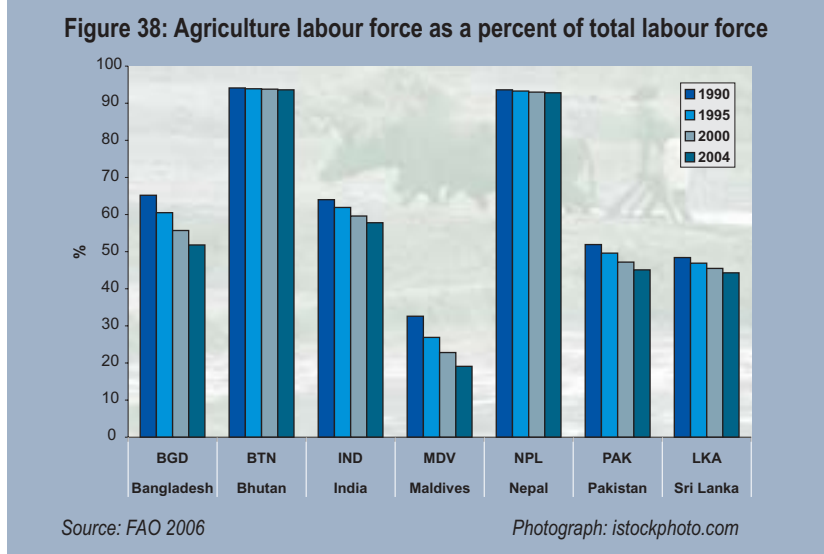
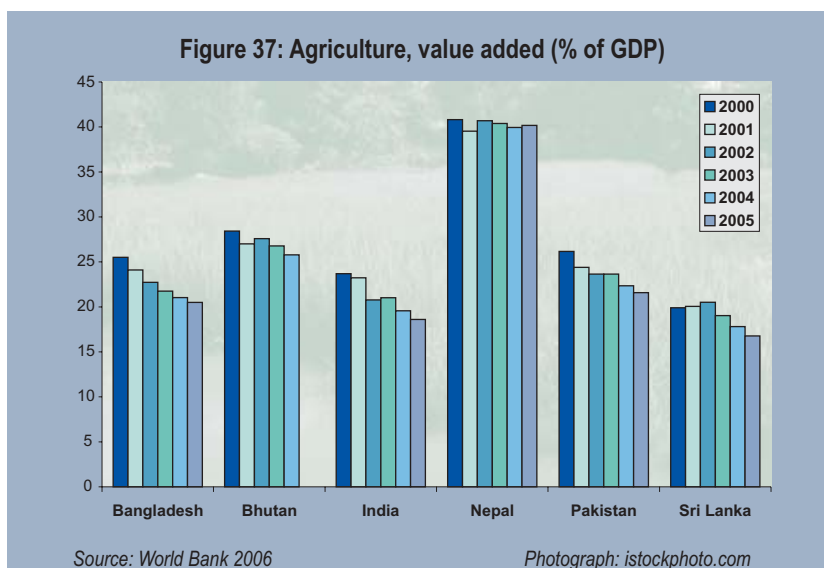
As seen from figure 37, agriculture continues to play a pivotal role in the economies of these countries, although its share is declining, and has come down to nearly 17 per cent of GDP in Sri Lanka and 19 per cent in India. It remains a dominant sector in terms of employment in all five countries as is evident in figure 37.

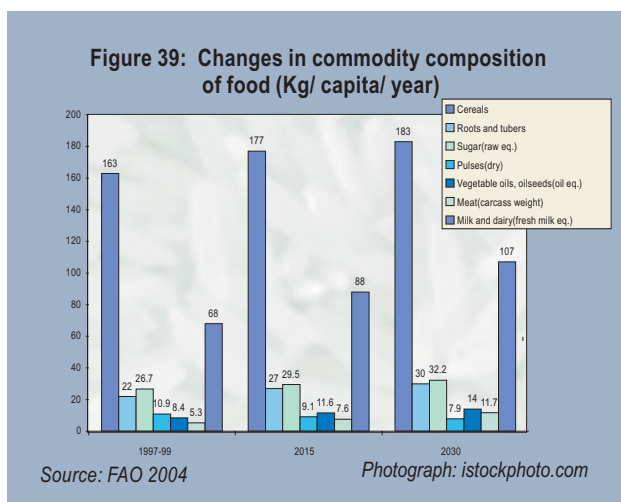
The percentage of the population, who depends on agriculture as a source of income, remains between 50 and 60 per cent in these countries (Figure 38). This indicates that the value of production in agriculture as well as the productivity level continues to be low.

The gradual withdrawal of the workforce employed in agriculture could be attributed to the availability of surpluses from agriculture for investment in non-agricultural sector. The direct and beneficial growth of agricultural output would be on the income and employment of these workers increasing their purchasing power and leaving them less susceptible to food insecurity.

Changes in food composition

Another important aspect of food availability is a change in diet composition of various population groups, indicating a rise in the share of non-cereal consumption in general and animal products in particular. Food-grain production is the dominant sub-sector of their agriculture. Growth in agricultural output, particularly in food-grain production is important from the point of view of availability, stability, as well as access to food for the large masses. The countries in this region could make a dent in the problem of food insecurity by raising the level of domestic food grain production, particularly of cereals. At lower income levels, cereals and other vegetable products are the main source of calories. It is only at a later stage of development that non-cereal food grains, i.e., animal husbandry and fisheries products, gain in importance. This suggests an increase in the availability of calories at a faster rate than the availability of food grains, particularly cereals. At the same time, changes in the dietary composition, i.e., shift to superior cereals and animal husbandry products, suggest that the cost of calories has increased.





Changes in dietary composition generally take place with the rise in per capita income, due to higher income elasticity of demand for superior cereals and for non-cereal foods (fruits, vegetables and animal husbandry products). Records of different countries are not uniform in this respect, but improved availability of food grains and of the quality of food is a common feature of most countries in this region. However, the per capita availability of low-cost nutritious food, especially pulses, has declined. This raises the question whether the improvement in the quality of diet is also true for the poorer groups.

Table 16: Food Consumption

South Asia	1997-98	2015	2100
(kcal/capita/day)	2403	2700	2900
Incidence of under-nourishment, developing countries			
% population	24	12	6
Million people	303	195	119

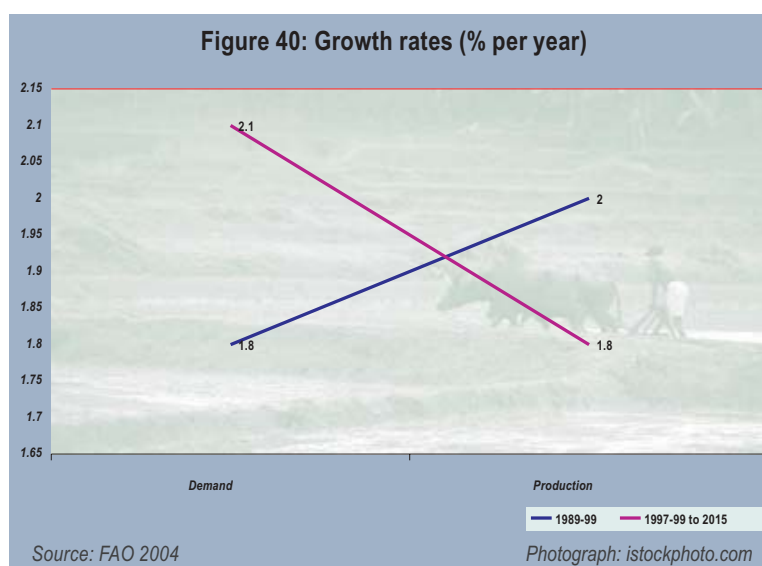
Source: FAO 2004

Looking at the future

Additionally, the disparity between demand and supply of agricultural outputs contributes to food insecurity. As seen from the projection in figure 40, the demand for agricultural outputs would far exceed the supply, despite an anticipated rise in GDP.

Also the self sufficiency ratio (SSR = Production / total demand) is expected to decline in the coming years by 6.86 per cent which would directly impact net trade of cereals in the region. All these factors would collectively add on to the food insecurity in the region.

Agriculture is both the cause and victim of environmental pollution. South Asian farmers have turned increasingly to chemical fertilizers and pesticides to improve crops and to maximize yields. Although this has produced a short term increase in yields, it has permitted over-cropping, which has reduced the available organic matter in the soil. Humus loss reduces the ability of the soil to retain water, speeding precipitation runoff, increasing the probability of flooding and water erosion, and making the region more vulnerable to drought.



Dangers of intensive farming

There is an increase in fertilizer consumption over the years, with India being the highest consumer. Also, fertilizer-use intensity is increasing, which would put additional strain on the already scarce freshwater resources in the region.

The increase in water use intensity and poor agricultural practices (such as over-extraction of water for agriculture) have reduced the availability of water in the downstream areas and led to saltwater intrusion.

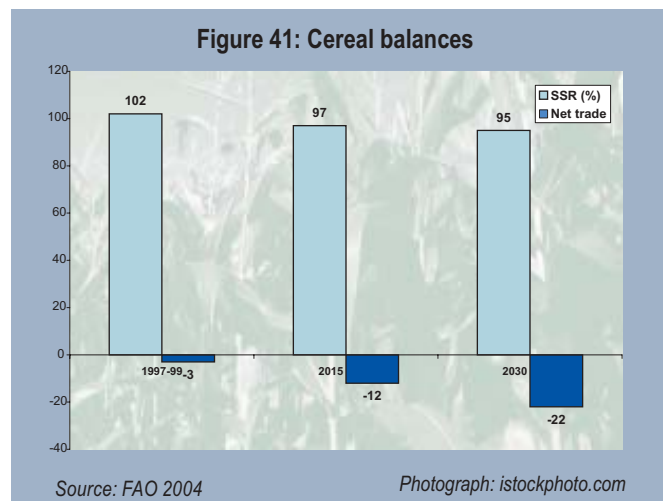


Figure 42: Fertilizer consumption (Thousand metric tons)

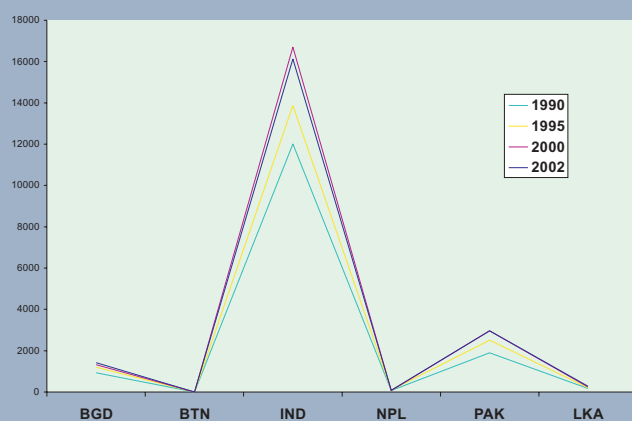
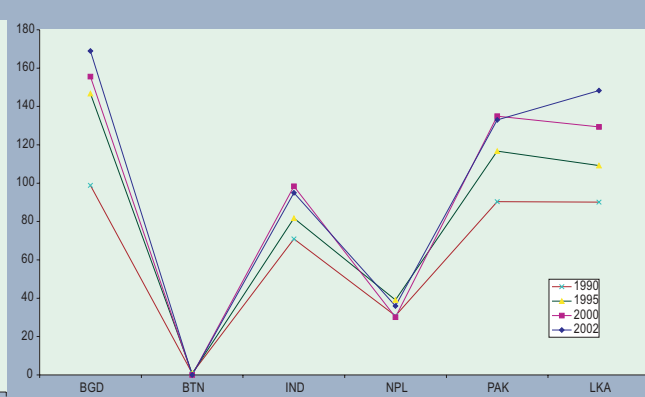


Figure 43: Fertilizer use intensity (Kilograms per hectare)



Water use intensity is the highest for Bangladesh, followed by Pakistan. This has resulted in the degradation of the existing available land area under agriculture, lowering productivity in the short run and rendering it unfit for cultivation in the long term.

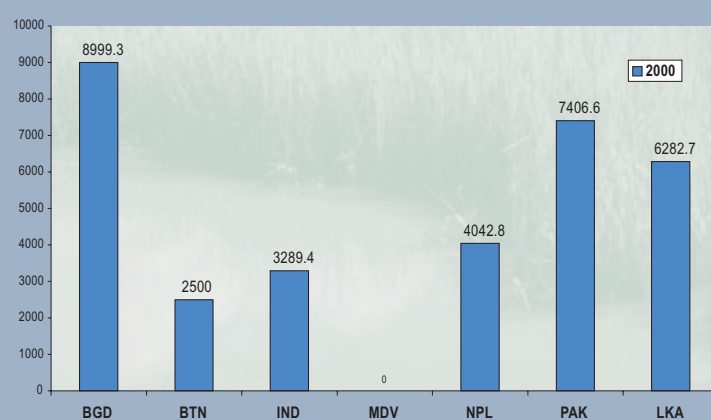
Food crises and disasters

South Asia is a disaster-prone area. Large parts of the region are subject to floods and droughts, sometimes both. Volcanic eruptions, fire and frost are common occurrences.

There is a view that deforestation and extension of cultivation on marginal lands have increased the incidence of natural disasters. The countries of the region have perfected the art of coping with natural disasters to a great extent, but each country has to fend for itself, even when a calamity is spread over more than one country. The region will benefit from an early warning system that will forewarn the countries about the impending calamity. With modern advances in techniques and instruments of surveillance, this would be a manageable undertaking.

Bangladesh and coastal parts of India and Pakistan are threatened quite frequently by cyclones and floods. Recurring droughts are a common feature in the arid and semi-arid parts of India and Pakistan. Incidence of natural calamities is

Figure 44: Water use intensity (m³/ha/yr)



more severe on the food insecure households. The respective governments also have to devote large resources to cope with frequent natural disasters.

The power of technology

Food security can be addressed through several options and strategies by using technology, institutions and policy alternatives. One of the reasons for continued food insecurity in the region is the low productivity of crops and livestock in the region as compared to many developing and developed countries. Increasing productivity of crops through increased investment in agriculture research and development that focuses on crops grown and consumed by the poor is needed. The investment in agriculture research as a percentage of agriculture GDP has been declining in many of the South Asian countries. The trend has to be reversed in order to develop new technologies that will reduce the food insecurity.

Biotechnology

Biotechnology can improve crop productivity and food crops should be explored with the challenges in developing the biotechnology policy, bio-safety regulations and capacity for using biotechnology. Increasing the nutritional content of food consumed by the population, as well as increasing the resistance to biotic and abiotic stresses through biotechnology, can help solve the food insecurity problem in the region. The use of better technology for minimizing environmental harm from the intensive cultivation of food crops is also important. The use of remote sensing technology to minimize weather fluctuations will help in forewarning drought-related food production challenges

Improvements in technology transfer through institutions

There is a need for better linkages between agricultural research and technology-transfer. The extension systems that were successful in transferring technology to the farmers during the Green Revolution period have declined, both in terms of quantity and quality. Unless the extension systems of the South Asian countries are revived through better partnership of public and private institutions, the adoption of new technologies by the farmers will lag behind. Use of information technology to transfer knowledge across the countries as well as within the countries, is important. Understanding the benefit of information and communication technologies in transferring information for increasing the productivity of farmers will help in reducing food insecurity. Furthermore, use of Geographical Information Systems (GIS) and Global Positioning Systems (GPS) for identifying opportunities for precision agriculture will help in reducing the waste of inputs such as water and fertilizer and in increasing the productivity of South Asian agriculture.

The large scale adoption of superior technology, for example the spread of High Yielding Varieties in areas suitable for their adoption, has increased the chances for raising agricultural production. But, there is now a growing apprehension that the "technology shelf" is almost empty. It is important to raise the level of yield-augmenting technology. It is also clear that a few precautions not exercised in the past, have to be taken to make the agricultural growth sustainable and these include:

1. a greater concern for environmental and ecological factors. Care has to be taken that the natural resource base for agriculture is not damaged. This particularly applies to the efficient use of water resources. Raising productivity in water use in a cost-effective way is as important as increasing land productivity;
2. research and development efforts should be geared towards evolving labour-intensive yield-augmenting technologies, i.e., the type of technologies which could be more easily adopted even on the small, resource-poor farms;
3. to the extent feasible, research should be geared to develop more robust varieties, i.e., those which can withstand the vagaries of nature;
4. systematic efforts should be made to bring the fruits of technological advances for crops grown in the poor regions by the poor farmers; and
5. to the extent possible, research on, and extension of, nutritionally superior crops and varieties should be encouraged.

Measures to reduce food insecurity

Long-term investments in agricultural research and rural infrastructure (roads and irrigation), coupled with price policies providing adequate incentives for domestic production, have led to substantial gains in food production and real incomes in many Asian countries. Reduction of post harvest losses also will largely reduce the food insecurity. Some future trends towards improved agricultural productivity will address food insecurity. Improved communications and roads will allow food to be transported more quickly into drought or flood affected areas.

Improving agricultural productivity

The countries in the region have reached the limits of extensive cultivation, and the scope for further expansion of cultivated area is not very bright. In fact, there is a need to withdraw some of the marginal lands as cultivation has been extended to areas that are ecologically unsuitable for crops. At the same time, the possibility of encouraging food grain production by raising land productivity is quite substantial, primarily because the yield levels of most crops grown in these countries are still fairly low. The countries have used non-price as well as price measures to induce farmers to produce more.

The route towards increasing agricultural productivity in a sustainable and equitable manner lies mainly in:

Strengthening infrastructure and delivery systems

The agrarian structure in these countries is dominated by small and marginal holdings. On the other hand, the delivery systems, i.e., institutions for input supply, credit, marketing, and extension, serve medium to large farmers rather than those with small farms. The transaction costs of these institutions rise once their operations are brought to the level of the marginal farmers. This makes them bypass the small farmers. The congruence between the recipient system, characterized by the small and marginal farmers, and the delivery system geared to the requirements of large holdings, does not exist. This has to be provided principally through institutional innovations.

Reviving rural infrastructure

The widespread neglect of the 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 fertilizers and reduced farm output prices, severely blunting incentive farming. 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.

Institutional reforms

Institutions could also play an important role in improving access to food. Well functioning institutions that facilitate the smooth transfer of produced food to consumers are important. National level institutions



Research should develop varieties, which can withstand the vagaries of nature

Photograph: Vasant Dave

such as the Public Distribution System in India should have adequate access to remote areas in order to improve food security at the local level. Food insecurity has been high in areas where the public distribution system has not been functioning effectively. The role of food parastatals as an institution in procuring and distributing food in the region must be revisited because it is becoming increasingly clear that the parastatals that participate in procurement and distribution of food have become inefficient, partly due to poor governance and accountability. Reforming these institutions to better serve the poor by reducing cost and increasing benefit to the poor will improve access to food (Rashid et al., 2005).

Policy reforms

The policy priorities for improving food security and nutrition in South Asia include greater public investment in agriculture as well as in the social sectors. For example, an additional US\$ 50 billion investment in South Asia in the social sector will reduce child malnutrition by 13 million (Smith, et. al. 2000). Improving access to productive resources and employment for vulnerable sections of society is also important. Greater linkage between agriculture research and food policy should be pursued in order to translate agriculture technology into adequate food security. Recent trends indicate that community-based targeting programs work better in improving the access to food. However, policymaking should involve the poor farmers and vulnerable sections of society to directly benefit in terms of improved access to food. Greater involvement of the private sector is also required in establishing and maintaining food distribution centres in rural areas.

Another area that needs policy attention is to improve inter-regional trade liberalization in South Asia. Harmonization of customs and tariffs among the countries in the region to facilitate better food trade is needed. A multi-disciplinary approach is needed for greater involvement of nutritionists in policymaking. The early warning systems to forewarn of impending food shortages due to natural disasters should be developed in all of the countries in the region as well as at the regional level to increase cooperation to share such information among the countries. Effective communication that is user-specific and user-sensitive to various levels of decision making is also important for scientists as well as policymakers for solving the food security problem in the region.

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 (Leach, G. 1995). Radical reforms and a common position for South Asia on food pricing and trading are required to enable the large increases in production that are needed. The short-term market signals have to be overruled by longer term socio-economic and political considerations.

Good governance practices

Good governance is fundamental for increasing access to food and reducing food insecurity. Pro-poor policies should target the most vulnerable sectors of society. Food entitlement should reach the targeted population. Even well-functioning programs such as Integrated Child Development Services program (ICDS) do not fully address the problem of food access to the vulnerable population. Ownership rights on land and reduction in income inequality will also serve in terms of improving access to food. Minimum wages to guarantee the right to food as well as easy access to credit and marketing networks are also important for low income groups.

South Asia is home to successful examples of targeted food and nutrition intervention programs. For example, the Integrated Child Development Services (ICDS) has been the largest child nutrition intervention program in the world. In India's tenth five-year plan, it is envisaged that the program will be implemented throughout the country, providing universal coverage for the program. Yet, ICDS continues to face major implementation challenges and does not fully translate the investments made into adequate nutrition. The Tamilnadu Integrated Nutrition program, a variant of ICDS program, which is currently incorporated as part of ICDS, has shown that when effective monitoring and evaluation is conducted and appropriate follow-up activities are undertaken, child nutrition could in fact be improved through integrated nutrition programs (Dev 2005). The Food for Education program in Bangladesh provides adequate evidence that not only can food be transferred to poor households through targeted interventions, but it can also act

as an effective tool to bring children to school, particularly the girls (Ahmed and el Nino 2005). The food-based nutrition intervention program Triposha in Sri Lanka has also shown a positive impact on reducing child malnutrition

Local level initiatives

Every country should have programs 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.

References

- Ahmed, A. and el Nino, C. (2005) Feeding Minds While Fighting Hunger: Food for Education in Bangladesh. In *Economic Reforms and Food Security in South Asia*, S. Babu and A. Gulati (eds.). Haworth Press, New York.
- Babu, S.C. (2005.). Food Security in South Asia. In *Regional Cooperation in South Asia. South Asian Journal, July-September 2005.*
- Babu, S.C. (2003). Social Safety Nets for Poverty Reduction in South Asia – Global Experiences in Sri Lanka. *Journal of Agricultural Economics*, 2003, 5 (1): pp. 1-8.
- Dev, S.M. (2005) Market Reforms in Agriculture: An Indian Perspective. Babu, S. and Gulati, A. (eds.). *Economic Reforms and Food Security in South Asia*. Haworth Press, New York.
- Dorosh, P., Del Ninno, C. and Shahabuddin, Q. (2004). The 1998 Floods and Beyond: towards a Comprehensive Food Security in Bangladesh. The University Press and The International Food Policy Research Institute.
- Islamm Y. and Garrett, J. (1997) *IFPRI and the Abolition of the Wheat Flour Ration Shops in Pakistan: A Case Study on Policymaking and the Use of Impact of Research*. Impact Assessment Discussion Paper No. 1. The International Food Policy Research Institute.
- FAO (2004) *World Agriculture: Towards 2015/2030*, Summary Report. FAO Corporate Document Repository. Food and Agriculture Organisation of the United Nations. <http://www.fao.org/docrep/004>
- FAO (2004) *Poverty Alleviation and Food Security in Asia: Lessons and Challenges*. FAO Corporate Document Repository. Food and Agriculture Organisation of the United Nations. <http://www.fao.org/docrep/004>
- Independent South Asian Commission on Regional Poverty Alleviation (2003). *Our Future Our Responsibility, Road map towards a Poverty Free South Asia*. A Report of the Independent South Asian Commission on Regional Poverty Alleviation.
- Leach (1995). *Global Land and Food in the 21st Century, Trends and Issues for Sustainability*. Polestar Series Report No. 5. Stockholm Environment Institute.
- Rashid, S.R.C. and Gulati, A. (u.d.) *Grain Marketing Parastatals in Asia: Why do they have to Change Now? Markets Trade and Institutions Division Discussion*. Paper 80. The International Food Policy Research Institute.
- Smith, L. and L. Haddad, L. (2000) *Explaining Child Malnutrition in Developing Countries: A Cross-country Analysis*. IFPRI Research Report. The International Food Policy Research Institute.
- UNEP (2001). *State of Environment South Asia 2001*. United Nations Environment Programme.
- World Bank (2005). *Agriculture and Achieving the Millennium Development Goals*. The World Bank.
- World Bank (2006). *World Development Indicators*. The World Bank.



The disparity between demand and supply of agricultural outputs is the main reason for food insecurity

Photograph: Philip Niewold



Water Security

Water security is emerging as an increasingly important and vital issue for the South Asian region. Many South Asian countries are beginning to experience moderate to severe water shortages, brought on by the simultaneous effects of agricultural growth, industrialization and urbanization. Another concern in the region is growing competition over shared water resources. These shortages would be further aggravated by receding of glaciers and dwindling fresh water resources. Water stress is likely to be a major impact of climate change, with some of South Asia's major rivers such as the Indus and Brahmaputra projected to fall by as much as a quarter.

In South Asia, conflict over freshwater resources can strain relationships between various countries sharing these resources. In the future, diminishing and degraded freshwater resources could lead to internal instability in many nations, and possibly even spark interstate conflict.

South Asia has always faced water scarcity, especially in its arid and semiarid areas; and rapid urbanization and industrial development, have made the problem more acute. Farmers, cities, and industry, now routinely vie for the same water supplies. Irrigation systems, once the preserve of farmers, are now often tapped to supply factories and urban areas, as developing new water systems need large investments. There are many factors that influence the availability and access of water.

Irrigation requirements

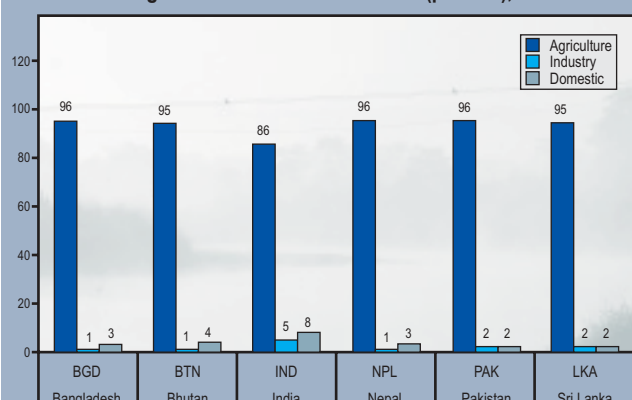
The growing demand for food is a significant factor determining the supply of available freshwater. About half of the water that is used for irrigation is lost to seepage and evaporation. Irrigation is also a major concern for many South Asian countries; India, Pakistan and Sri Lanka have in excess of 30 per cent of their total cropland under irrigation. While irrigation is a vital for increasing crop yields, it can also be extremely dangerous when mismanaged and could result in the erosion, water-logging, and salinization of the soil, which is less fertile. Poorly managed irrigation can also result in water pollution and water-borne diseases.

The primary use of water in South Asia is for agriculture. As more food will be needed in the future, due to population growth, there will be greater demands placed on the region's water supply. Almost 90 per cent of the water supply, in South Asia, is used for agriculture and thus is unavailable for other uses (figure 45). This requirement is likely to increase in the future as agriculture is extremely dependent on an adequate freshwater supply. In South Asia the growing demand for food is a significant factor determining the supply of available freshwater.

The area of arable land under irrigation is also likely to increase from 81 million ha to 95 million ha in 2030 (figure 46).

Table 17 gives examples of water required per unit of major food products, including livestock, which consume the most water per unit. Cereals, oil crops, and pulses, roots and tubers consume far less water. Changing food habits, as mentioned in the food security section, with a shift towards meat and dairy products would result in greater stress on the fresh water resources (Table 17).

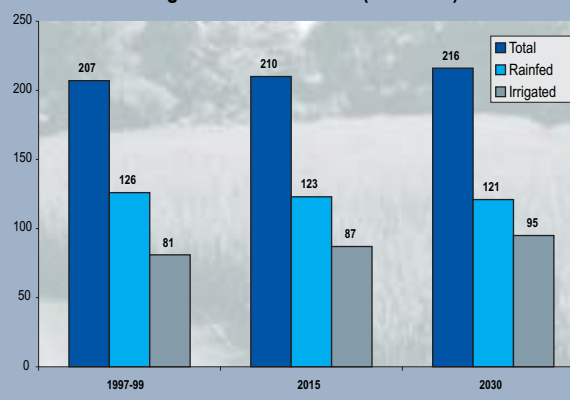
Figure 45: Sectoral Withdrawals (percent), 2000



Source: FAO 2004

Photograph: istockphoto.com

Figure 46: Arable Land (million ha)



Source: FAO 2005

Photograph: istockphoto.com

Rapid industrial growth

Another important factor that influences the state of water security in a particular country is its degree of industrialization. Industries account for roughly 25 per cent of the world's water use and the amount is much higher in industrial countries (as high as 50-80 per cent). In South Asian countries the maximum utilization was 5 per cent for India and just 1 per cent for Bangladesh, Bhutan and Nepal. (FAO 2000). Industrial activity requires large amounts of freshwater for activities such as boiling, cleaning, air conditioning, cooling, processing, transportation and energy production. As developing countries industrialize, they will use even greater quantities of water.

Table 17: Water Requirement Equivalent of Main Food Products

Product	Unit	Equivalent water (In m3 per unit)
Cattle	Head	4,000
Sheep and goats	Head	500
Fresh beef	Kg	15
Fresh lamb	Kg	10
Fresh poultry	Kg	6
Cereals	Kg	1.5
Citrus fruits	Kg	1
Palm oil	Kg	2
Pulses, roots and tubers	Kg	1

Source: UN/WWAP 2003



Increasing industrialization will add, greatly to water pollution

Photograph: Development Alternatives

The positive side of this trend is that water used in industrial processes can be recycled, since - unlike in agriculture - very little of it is actually consumed. In developed industrial countries, the primary impetus for water recycling is compliance with pollution laws. Since it is often more economical to comply with pollution laws by recycling water, less is wasted. Unfortunately this is not apparent in poorer developing countries, where few governments provide industry with incentives to adopt more efficient water-use practices. Consequently, although the amount of water being used for industrial purposes is decreasing in the developed world, it is actually increasing in poorer, developing countries. This further strains freshwater resources in countries already facing rapid urbanization.

Challenges

Pollution

Environmental factors (such as pollution or climate change) can also influence water security for a particular nation or region. Most countries in the region routinely dump human and industrial waste into their rivers and lakes. In developing countries, roughly 90-95 per cent of all domestic sewage and 75 per cent of all industrial waste are discharged into surface waters without any treatment. In many parts of South Asia, pollution is a major culprit behind the dwindling availability of freshwater. Scarcity of fresh water resources due to pollutions is a serious concern in co-riparian states, especially in rivers having varying inflows during winter and summer. All of India's 14 major rivers are polluted, primarily because they transport 50 million cubic meters of untreated sewage into India's coastal waters every year. New Delhi alone is responsible for dumping more than 200 million litres of raw sewage and 20 million litres of industrial wastes into the Yamuna River as it passes through the city on its way to the Ganges.

Oil pollution

Up to 50 per cent of the oil pollution in the South Asian marine environment comes from the numerous river craft and steamers plying the waterways. Other sources of oil and toxic pollutants are the big ship breaking yards in countries like Bangladesh, India and Pakistan. In India, ship breaking is carried out over a distance of just 10 km on the beaches of Alang in Gujarat.

Whilst there are 18 major ports and about 30 ports of intermediate size within the region, only one of the countries, India, is a large importer or exporter of oil. Whilst the number of major oil pollution incidents in the South Asian Seas region has been small, the transit of large volumes of seaborne oil together with increasing oil importation by India and Pakistan represents a 'Medium Risk' overall. With the exception of India, South Asian countries do not have the capability to deal effectively with a spill of more than 100 tonnes in sheltered waters. Assistance from neighbouring states or from outside the region is envisaged for incidents beyond national capabilities.

Oil spills can have serious impact on various natural physical, chemical and biological degradation processes. The effects of oil spills can be far-reaching, from environmental as well as socio-economic perspectives. Marine and coastal habitats, wildlife species, recreational activities, local industry, and fisheries, are among the resources and sectors that can be negatively affected by oil spills.

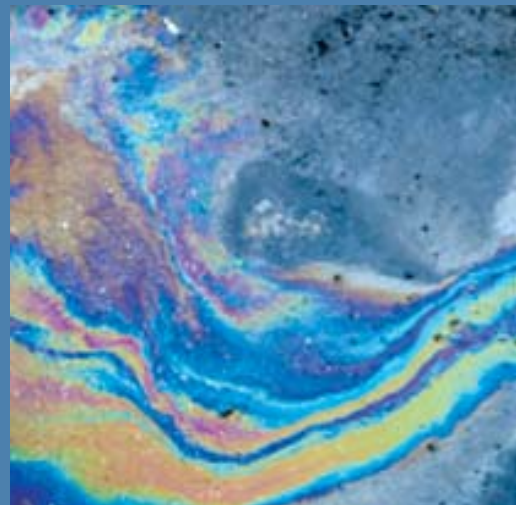
Significant Impacts

Box 16: Oil Spills in the Indian Ocean

On 15 August 2006, about 470 km (290 miles) from the coast of India, the Japanese operated oil tanker, Bright Artemis, collided with a smaller cargo ship it was attempting to assist.

The result was an oil spill of about 5.3 million litres (1.4 million gallons) of crude oil.

The spill occurred hundreds of kilometres away from land, so substantial impacts on inshore and coastal environments are unlikely. However, the effects of 'at sea' spills are less understood than the when more obvious, an when an oil spill washes up to the shore and could include oiling of offshore seabirds; impacts on marine mammals and turtles; and toxicity to organisms occupying surface water layers, including eggs and larvae of many fish species



Source: Greenpeace 2006

Habitats: Exposed rocky cliffs and seawalls, wave cut rocky platforms, sandy beaches, mixed sand and gravel beaches, tidal flats, marshes, mangroves, coral reefs.

Wildlife: Oil spills have an effect on sea birds, marine mammals, fish and shellfish, and bottom-living animals.

Economy and health: Destroyed beaches, destroyed aquaculture, destroyed fisheries, health effects from cleanup operations are all consequences of oil spills

Climate change

Another potential environmental threat to water security in Asia is global warming and climate change. Changing weather patterns could result in droughts in areas accustomed to plentiful rainfall and vice versa.



Careless extraction of fossil fuels could lead to impacts on marine biodiversity

photo: istockphoto.com

Table 18: Major Tanker Spills of over 5000 Tonnes in the South Asian Seas Region Since 1974

Vessel Name	Quantity spilled (tonnes)	Type	Country	Year	Cause
TASMAN SPIRIT	32 000	Crude	Pakistan	2003	Grounding
CRETAN STAR	29 000	Crude	India	1976	Hull Failure
CHERRY VINSTRA	16 000	Crude	India	1974	Hull Defect
AVILES	11 000	White	India	1979	Fire/Explosion
TRANSHURON	5 200	Crude	India, Laccadives	1974	Grouping

Source: ITOPF 2003

Land degradation

Land degradation is another environmental variable that can influence the availability of water. As countries experience greater urbanization or deforestation, less land is available to absorb and hold water. Degraded land usually has reduced vegetative cover and the soil is less able to hold water; consequently, rainfall likely results in flash runoff. This leads to reduced seepage and aquifer recharge. In India, land degradation has resulted in reduced aquifer recharge, even in areas that receive large amounts of annual rainfall. As a result, many village authorities in high rainfall regions in India petition the central government for drought relief.

Population stress

When looking at future scenarios involving water, it is important to consider human population growth. At the beginning of the twentieth century, the world's population was roughly 1.6 billion people, but by 1990, it had increased to around 5.3 billion - an increase of about 330 per cent. Currently, the world's population is increasing by around 80 million per year and is expected to reach 8.5 billion by the year 2025 (APCSS, 1999). Roughly half of this population will live in Asia - although Asian countries only occupy about 16 percent of the world's total land surface. Population growth in Asia is seen as a major challenge for water security in the region.

Related to population growth is the growing trend of urbanization, a phenomenon that is especially apparent in Asia. Among other things, urbanization is expected to shift water out of agriculture and in to drinking water supply for growing cities.

Inefficient water use

A key factor in water security is the degree of wastage that occurs. If water were used more efficiently—in agricultural, industrial, and municipal settings—it could help insure water security. In many irrigation systems, as little as 37 per cent of the water used is actually absorbed by crops; the remainder is lost through evaporation, seepage or runoff. According to FAO, more than 10 to 20 per cent of the water used for agricultural purposes could be saved if more efficient irrigation methods were utilized. Water in urban areas is also wasted. In developed countries, experts calculate that about 10 per cent of water is lost due to leaks in municipal water networks; in developing countries, this number could be as high as 60 per cent.



The efficient use of water will reduce water insecurity

Photograph: Development Alternatives

Freshwater: a security concern

In the post Cold War era, the definition of security is being expanded to include a host of non-traditional issues such as environmental degradation and transnational crime. In some quarters, the availability of clean freshwater is increasingly being characterized as a security issue.

One could argue that perhaps water security really is not a security concern in and of itself, or that it should fall under the larger rubric of "environmental security" or "resource depletion. This threat could manifest itself in a number of different ways, such as directly in the form of violent conflicts over freshwater resources, or indirectly, by causing large-scale migration and food shortages. It was also recognized that to fully appreciate the complexity of the water security issue, it has to be viewed on three basic levels.

Box 17: Negative Consequences of Groundwater Overdraft

Groundwater overdraft has many negative consequences. The most far-reaching impact of groundwater depletion and water quality deterioration is on the health of large sections of rural populations that depend directly on wells as their only source of drinking water supply.

Examples are:

- ❖ In western and peninsular India, overuse of the resource is depleting water tables. Groundwater mining is causing the drilling of ever-deeper wells and an ever-increasing cost of tapping these aquifers.
- ❖ In India's Gujarat and Rajasthan States, groundwater overuse is causing fluoride contamination of drinking water supplies, creating a major public health crisis.
- ❖ In Bangladesh and West Bengal, overexploitation causes arsenic contamination of groundwater.
- ❖ In coastal India, overexploitation of groundwater results in high levels of salinity in the water, making it unfit for human consumption or farming.
- ❖ In Pakistan's Indus River system, a major challenge is how to deal with secondary salinization of water and land. This is caused by inappropriate practices for the combined use of surface water and groundwater.



In most rural areas, groundwater overdraft is a serious concern

Photograph: Development Alternatives

Source: IWMI 2001

Human security and health

Freshwater can become a security issue when it is linked to so-called "human security", which encompasses a variety of issues that have an impact on human health and wellbeing. From this perspective, water is a clear security problem if one considers the large number of human deaths that occur as a result of unsafe or inadequate water. Approximately 25 000 people die every day from water related diseases (Population Reports 1998). In Bangladesh, it is estimated that three-quarters of all diseases are linked to unsafe water and inadequate sanitation facilities. Experts estimate that about 60 per cent of all infant mortality throughout the world is tied to infectious and parasitic diseases, most of them related to water. Diseases such as diarrhoea, moreover, are prevalent in countries with inadequate sewage treatment. An estimated 4 billion people per year contract diarrhoea and among that number approximately 3 to 4 million die annually. Most of these people are young children. Unsanitary water is clearly a major health threat for millions in the developing world.

Security and governance

The specific impact of freshwater on intrastate security is far more complex and less easily ascertained. Although the potential for conflicts among countries over shared water resources receives much attention in the popular media, its impacts within nation-states are far more insidious and indirect. Water insecurity constrains economic development and contributes to a host of corrosive social behaviors that can, in turn, produce violence within societies. Freshwater scarcity, often causally related with other factors, such as poverty, population growth, infrastructure problems, environmental degradation, can escalate the aforementioned "human security" problem into a national security issue. Water security can be the catalyst for large-scale migration and ethnic conflicts.

Regional issues

Water security issues can have a destabilizing effect on regional security. Spawned by globalization, the increasing economic and political interdependence of nations, ultimately, means greater potential for spillover of problems. Ethnic unrest, mass migration, and declining economic conditions, fanned by freshwater scarcity, are not likely to be confined neatly within a country's borders. Additionally, the same factors that undermine the domestic effectiveness of a government systematically erode its ability to interact on an international level. This can have an adverse affect on negotiation and implementation of a wide variety of international agreements that range from collective security to economic and global environmental issues. Water is increasingly viewed as a strategic resource, one that is to be protected and valued. Consequently, when one or more countries share water resources, the potential for disputes or conflicts is always present.

Intrastate water disputes

Political conflict between nation-states over access to water rights is partly the result of unsettled questions in international law. Four major approaches to water rights include: absolute sovereignty, prior appropriation (acquired and historical), riparian, and equitable utilization. The first two, absolute sovereignty and prior appropriation, tend to benefit upstream states at the expense of all other parties. For example, under principles of absolute sovereignty (also known as the "Harmon Doctrine"), a state can do what it pleases with its water resources regardless of any impact on a neighbouring state. This is similar to the prior appropriation doctrine ("first in time, first in right") that was common in the western United States during the early 1800s. Under this doctrine, the upstream party has first rights to the water; only if it does not use them, do other parties have a chance to determine usage.

The above principles appeal to upstream nations, and particularly,



The freshwater scarcity issue is rarely confined within countries borders

Photograph: istockphoto.com

to strong and powerful upstream nations. However, more equitable approaches to water rights are encapsulated in principles such as riparian rights and equitable utilization. Equitable utilization tends to benefit both upstream and downstream states and is especially beneficial to a weaker country that happens to be a downstream state. Water sharing conflicts in South Asia is exacerbated by the fact that most countries have mainly agrarian economies.

Water disputes are likely to occur since 54 rivers flow from India into Bangladesh. Although the Joint Rivers Commission was established in 1972 as the facilitating body to resolve transboundary water disputes between both states and was complemented by the Ganges Water Agreement in 1977, several water-related disagreements continue to exist between both states.

Measures to enhance water security

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 overexploitation 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.

Box 18: Area Water Partnerships

There has been much attention in recent times on Area Water Partnerships (AWPs) in South Asia. The year 2005 saw two region-wide studies of these local-level institutions to assess the function and activities and the future direction of AWPs. South Asia pioneered the concept of AWPs, as means of implementing IWRM at local and river basin/ sub-basin level. AWPs are established by the relevant country water partnerships and have the potential to function as informal multi-stakeholder platforms for conflict resolution and to foster better awareness of IWRM among competing user groups.

AWPs provide neutral platforms and forums for a wide range of stakeholders at local level to dialogue on critical water management issues as well as to initiate action to resolve them. Furthermore, they provide the forum for up-scaling issues that cannot be resolved at that (local) level to higher levels of policy and decision-making.

AWPs in different countries are at varying stages of development and tackle different issues such as groundwater quality, awareness raising, sanitation, watershed protection, pollution, sand mining and conservation. Regional cooperation, government support and financials are required to make this programme a success for solving water management and security concerns.

In 2005

- ❖ India conducted a National Seminar on Area Water Partnerships in Nashik in December
- ❖ Sri Lanka launched the Mee Oya AWP
- ❖ Bangladesh launched the Matamuhari AWP
- ❖ Nepal completed their study on the Indrawathie Basin in view of forming an AWP
- ❖ Pakistan held a capacity building workshop for AWPs in Islamabad
- ❖ Pakistan launched the Loralai AWP in May

Source: GWPSA 2006

The South Asia Chapter of the Global Water Partnership (GWP) is a stakeholder forum with members from several countries of South Asia. It works as a regional body to influence laws, policies and programmes in member countries with a focus on addressing environmental issues relating to water. Through its network, the GWP fosters integrated water resources management (IWRM). IWRM aims to ensure the coordinated development and management of water, land, and related resources in order to maximize economic and social welfare - without compromising the sustainability of vital environmental systems.

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 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 Myanmar).

There have been some efforts at regional cooperation in this field. Bilateral initiatives such as Joint River Commissions are responsible for working out the modalities of sharing of the waters of common rivers. The development of the rivers basin requires increased multilateral cooperation among South Asian countries.

Box 19: United Solutions: South Asia Capacity Building Initiatives on Water

Integrated Water Resources Management (IWRM) has emerged as a logical and appealing concept to dealing with water related problems. The integrated approach to water resources management helps to protect the environment, promote economic growth and sustainable agricultural development and improve human health as it considers the different uses of water resources as well as its economic and social aspects. All over the world, water policy and management have been identified to be interconnected to the nature of hydrological resources, and integrated water resources management is emerging as an accepted alternative to the sector-by-sector, top-down management style that has dominated water resources management in the past.

The Crossing Boundaries (CB) project, funded by the DGIS, the Government of Netherlands, aims to contribute to the paradigm shift in water resources management in South Asia, summarised in the concept of IWRM (Integrated Water Resources Management), by means of a partnership-based programme for capacity building of water professionals on IWRM and gender & water through higher education, innovation and social learning focussed research ('research with an impact'), knowledge base development and networking.

SaciWATERs, the South Asian Consortium for Interdisciplinary Water Resources Studies, based in Hyderabad, India and the Irrigation and Water Engineering group at Wageningen University are implementing the project with six South Asian partner institutions namely; a) Bangladesh Centre for Advanced Studies (BCAS), Dhaka, Bangladesh, b) Institute of Water and Flood Management, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh, c) Centre for Water Resources (CWR), Anna University, Chennai, India, d) Tata Institute of Social Sciences (TISS), Mumbai, India, e) Postgraduate Institute of Agriculture (PGIA), University of Peradeniya, Sri Lanka, and e) Nepal Engineering College (NEC), Nepal. It is expected to involve other South Asia countries including Pakistan, Bhutan, Afghanistan and Maldives in project activities in future.

The major activities to be undertaken during the project period from 2005 to 2010 include the provision of 160 Master fellowships (85% female candidates) and 20 PhDs, short-term training for 435 working professionals, curriculum revision through 10 staff trainings, 10 "South Asia Water Series" to document new knowledge in various aspects of IWRM, 5 annual research workshops to disseminate leading edge research in IWRM in the region and 2 international conferences to discuss water resources policy in South Asia among researchers/educationalists/policy actors and practitioners.

Source: BCAS 2007

Participatory approaches

A participatory approach is an important prerequisite 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 optimize 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.

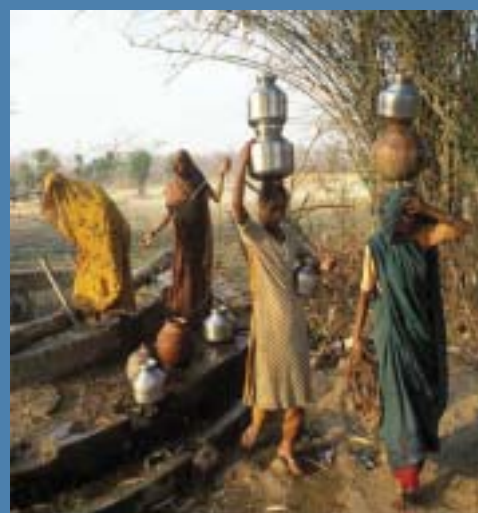
There is an urgent need for an awareness campaign to share experiences on the critical aspects of availability of water resource in terms of quality and quantity, conservation, etc. To achieve this, the services of Civil Society Organisations (CSOs) can provide a very important link between communities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

Rationalizing 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

Box 20: Successful Initiatives: Water Panchayat in Rajasthan, India

Rajasthan is one of the driest states in India with regular recurrence of droughts. Traditional water harvesting structures that were used to store and conserve water faced a gradual decay as increasing population pressure, deforestation, large-scale migration and a dependent mentality took hold. Large parts of the States were listed as a dark zone as ground water table was extremely low. Responding to the crisis, Tarun Bharat Sangh (TBS) was established in Alwar district in March 1975 with a mission to harvest and conserve water through revival of traditional water harvesting structures called johads and construction of new structures. The TBS mobilized people by undertaking padyatras and holding Panchayat meetings. The organization extended its activities to a holistic treatment of the catchment area of its water structures by taking up afforestation work. Over the years, TBS has built more than 4500 water harvesting structures based on indigenous technology and with locally available material. The community maintains these structures. In the process, the carrying capacity of land for fuel, fodder and food grains has increased considerably. Agricultural land under cultivation in the villages falling in the watershed has increased from around 20 per cent in 1985 to close to 100 per cent at present. Diversification of livelihood opportunities especially dairy industry is clearly visible in the area. Five rivers of the area viz.. Arvari, Ruparel, Sarsa, Bhagani & Jahajwali that had dried up earlier have become perennial.



Women had to travel long distances to fetch water

Photograph: Development Alternatives

Source: TBS 1999

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.



Hydro-power should be encouraged at local levels

Photograph: istockphoto.com

Recommendations in the Human Development Report

The Human Development Report (HDR), 2006, recommends the following three foundations crucial for ensuring water security in the region.

1. **Make water a human right and mean it:** "Everyone should have at least 20 litres of clean water per day and the poor should get it for free," says the report: While a person in the UK or USA sends 50 litres down the drain each day by simply flushing their toilet, many poor people survive on less than five litres of contaminated water per day, according to HDR research. The report advocates that all governments go beyond vague constitutional principles in enabling legislation to secure the human right to a secure, accessible and affordable supply of water.
2. **Draw up national strategies for water and sanitation:** Governments should aim to spend a minimum of one percent GDP on water and sanitation, and enhance equity. Water and sanitation suffer from chronic under-funding. Public spending is typically less than 0.5 per cent of GDP.
3. **Increase international aid:** The Report calls for an extra US\$3.4 to 4 billion annually: Development assistance has fallen in real terms over the past decade, but to bring the MDG on water and sanitation into reach, aid flows will have to double, says the Report. It states that progress in water and sanitation requires large upfront investments with a very long payback period, so innovative financing strategies like the International Finance Facility are essential. This would be money well-spent, according to the authors of the HDR report, who estimate the economic return in saved time, increased productivity and reduced health costs at US\$8 for each US\$1 invested in achieving the water and sanitation target.

References

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

BCAS (2007). Paper in the Crossing Boundaries Project. Bangladesh Centre for Advanced Studies.

Barber, CV (1998). Forest Resource Scarcity and Social Conflict in Indonesia. *Environment*, May 1998.

Bender, W. and Smith, M. (1997). Population, Food, and Nutrition. *Population Bulletin*, vol. 51, no. 4 Population Reference Bureau, Washington, DC

- Bert L. K. (1999). *Factors that Influence Water Security*. Paper presented to the Asia-Pacific Center for Security Studies Seminar on Water and Conflict in Asia. September 17, 1999. Honolulu,
- Butts, K.H. (1997). The Strategic Importance of Water. *Parameters*, Spring 1997
- CANA (2006). *Climate Change Impacts in Asia*. Climate Action Network Australia
- Greenpeace (2006). *Defending our Oceans*. Greenpeace
- Independent South Asian Commission on Regional Poverty Alleviation (2003). *Our Future Our Responsibility, Road map towards a Poverty Free South Asia*. A Report of the Independent South Asian Commission on Regional Poverty Alleviation.
- ITOPF (2003). *Regional Profiles: A Summary of the Risk of Oil Spills and State of Preparedness in UNEP Regional Seas Regions*. The International Tanker Owners Pollution Federation Limited.
- IWMI (2001). Overview: Sustainable Groundwater Management Theme . International Water Management Institute.
- Postel, S. (1997). *Last Oasis: Facing Water Scarcity*. pp 35, 136-137. W.W. Norton and Company, New York.
- Postel, S.L. (1998) Water for Food Production: Will there be Enough in 2025? *Bioscience*, August 1998.
- (1998). Solutions for a Water-Short World. *Population Reports* (vol. 26, no. 1) September 1, 1998.
- UNDP (2006). *World Water and Sanitation Crisis Urgently Needs a Global Action Plan*. United Nations Development Programme.
- UNEP (2001). *State of Environment South Asia 2001*. United Nations Environment Programme.
- UN/WWAP (United Nations/World Water Assessment Programme) (2003). *1st UN World Water Development Report: Water for People, Water for Life*. Paris, New York and Oxford. UNESCO (United Nations Educational, Scientific and Cultural Organization) and Berghahn Books



Effective water were in agricultural, industry, tourism and urban areas it could help insure water security
 Photograph: Brian Thomas

Energy Security



South Asia, with its population of above 1.6 billion, is home to about one fifth of the world's population. The availability of energy, that advances - or at least is compatible with - long term human well being and ecological balance, is a key to the sustainable development of this region. This aspect of sustainable energy supply is critical in the context of South Asian region, as it is poised for higher growth. This is evident from the fact that the growth rate in GDP in the South Asian region was about 4.2 per cent and 4.8 per cent in India during 2002, while the world average was about 3.0 per cent for the same year. The growth of economy, along with the population growth in South Asia, has resulted in rapid increase in energy consumption, which is well above the world average of Organization for Economic Cooperation and Development (OECD) rates. Thus, the South Asian region faces the 'sustainable development' challenge of meeting the rapidly increasing energy demand as well as conserving the natural resources and protecting the environment.

With both Indian and Pakistani annual GDP growth rates now in the 6 to 8 per cent range and an increasingly young and urbanized population throughout the region, already approaching 1.5 billion people, the South Asian states face instability unless they can quickly find external sources of energy. A future where these states will largely depend on petroleum imports, particularly given the increasingly competitive world market, means that energy security is a primary concern in their foreign policy.

Demands on energy

South Asia accounts for about 5.9 per cent of the world's commercial energy consumption. This does not include the non-commercial energy sources such as wood, animal waste and other biomass that account for more than half of the region's total energy consumption. Despite rapid rise in demand, South Asia continues to average among the lowest per capita energy consumption of 443 kilogram of oil equivalent (KgoE), which amounts to 26.2 per cent of the world average of 1692 KgoE. However, energy consumption per dollar of GDP is amongst the highest in the world, which indicates the inefficient utilization of energy.

Improved energy security is vital to South Asia's economic growth and stability, given that demand for energy in the region is expected to double over the next 15 years. South Asian nations rely heavily on imported energy, yet the region has large amounts of untapped energy resources. The lack of regional energy cooperation and trade compounds the problem. Energy cooperation has the potential to be mutually beneficial for all regional players, with some countries acting as net suppliers, some as net consumers, and some as net distributors of energy. Paucity or lack of capacity, awareness, development of regional energy



In rural areas, clean energy must be used as a substitute for fire-wood

Photograph: istockphoto.com

resources, and sustained regional dialogue is a barrier to increased regional energy cooperation and, therefore, economic growth and could lead to instability. (USAID 2006)

As seen from figure 47, the demand on energy resources is increasing as the countries are moving towards industrialization and more energy is required and consumed.

Commercial energy mix

The commercial energy mix in South Asia, as shown in table 19, is dominated by coal, followed by petroleum and natural gas. The energy mix varies considerably within the region, with India depending mainly on coal, Bangladesh on natural gas and in Sri Lanka, the dominant source being petroleum.

The commercial energy mix of South Asia is 44 per cent coal, 34 per cent petroleum, 13 per cent natural gas, 7 per cent hydropower and 1 per cent nuclear. Significant variation in energy mix is observed in the region. Bangladesh energy mix is dominated by natural gas (66 per cent), while India is heavily dependent on coal (55 per cent). Sri Lanka relies primarily on petroleum (82 per cent), while Maldives is fully dependent on petroleum (100 per cent). Pakistan relies mostly on oil (43 per cent) and natural gas (41 per cent). Nepal and Bhutan have an overwhelmingly high share of petroleum and hydropower (around 90 per cent).

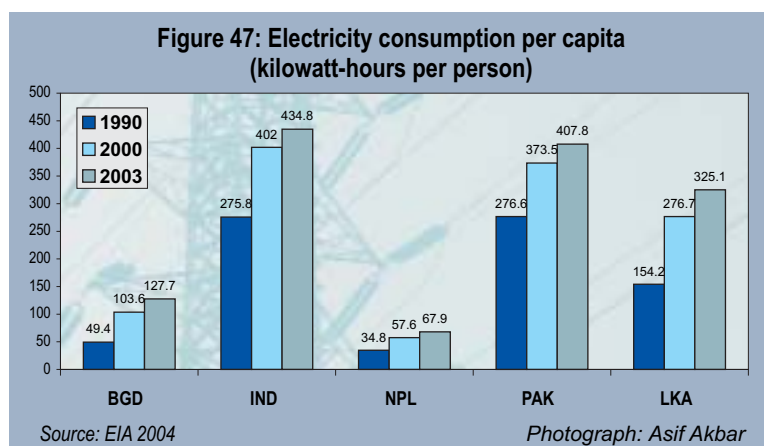


Table 19. Commercial Energy Consumption¹

Country	Total (Quadrillion Btu)	Petroleum	Natural Gas	Coal	Nuclear	Hydro-electric	Other ²	Carbon Dioxide Emissions ³ (Million metric tons of carbon)
Bangladesh	0.57	31%	66%	1%	0%	2%	0%	8.8
Bhutan	0.02	13%	0%	7%	0%	80%	0%	0.08
India	13.99	32%	7%	55%	2%	5%	0%	279.9
Maldives	0.01	100%	0%	0%	0%	0%	0%	0.2
Nepal	0.06	55%	0%	15%	0%	31%	1%	0.8
Pakistan	1.83	43%	41%	5%	1%	10%	0%	29.6
Sri Lanka	0.19	82%	0%	0%	0%	17%	0%	3.1
Total	16.67	34%	12%	46%	1%	6%	0.3%	322.5

Note:

- 1 Does not include such "non-commercial" energy sources as animal waste, wood, and other biomass, which account for more than half of South Asia's total final energy consumption.
- 2 Other includes consumption of wind electric power for India and net imports of electricity for India and Nepal. Other does NOT include biomass or other "noncommercial" sources of energy.
- 3 Includes carbon dioxide emissions from the consumption of petroleum, natural gas, and coal, and from the flaring of natural gas. Tons of carbon can be converted to tons of carbon dioxide gas by multiplying by 3.667.

Note: Percentages may not add to 100% because of independent rounding.

Source: EIA 2004

Oil reserves

South Asia contains reserves of only 5.7 billion barrels of oil or around 0.5 per cent of world reserves. In 2002, the region consumed around 2.72 million barrels per day (bbl/d) of oil, and produced approximately 0.70 million bbl/d, making South Asia a net oil importer of around 2.0 million bbl/d. The vast majority of South Asia's oil production (around 819 000 bbl/d in 2003) comes from India, whose offshore Bombay High field accounts for approximately one-third of total Indian oil output. Most of the remainder of South Asia's oil production comes from Pakistan (around 62 000 bbl/d in 2003).

Growing demand for transportation fuels and industrial power has been a major factor behind the recent growth in South Asian oil consumption. Between 1990 and 2000, South Asian oil consumption - led by India - grew by about 75 per cent. India's oil consumption is forecast to grow another 33 per cent by 2010, reaching 2.8 million bbl/d (up from 2.2 million bbl/d in 2002). In Sri Lanka, where oil is the dominant source of energy, oil consumption roughly doubled between 1991 and 2000. In 2002, Sri Lanka's oil consumption was 75,000 bbl/d. Sri Lanka imports all of its crude oil and uses it largely for electricity generation and transportation. The country has a refining capacity of 50,000 bbl/d. In recent years, Sri Lanka has further increased its oil imports in an effort to avoid over-reliance on hydroelectricity.

Power generation

In 2002, South Asia generated 642 billion kilowatt hours (Bkwh) of electricity. Of this, around 71 per cent was from conventional thermal power plants, 28 per cent from hydroelectric plants, 2 per cent from nuclear, and less than 1 per cent from "other renewables" (like wind and solar).

Also in 2002, India accounted for the vast majority (81 per cent) of the region's electricity generation, followed by Pakistan (13 per cent), Bangladesh (3.5 per cent), Sri Lanka (1 per cent), Nepal, Bhutan, and the Maldives (1 per cent total).

Regional electricity generation is expected to increase significantly in the coming years. Natural gas is expected to displace some coal-fired generation in India, although recently there have been delays in importing natural gas. Regardless, the net level of coal-fired generation in South Asia is expected to rise. Hydroelectricity is expected to fuel new generations, primarily in Nepal and Bhutan. Non-hydroelectric "renewable" capacity (i.e., wind, solar, ocean, biomass, geothermal) is small at present, but it is increasing, with solar and wind power being considered as most promising.

Electricity demand in most of South Asia is currently outstripping the supply, and the region is characterized by chronic shortages. Reasons for this situation include: shortfalls in the generating capacity; low plant load factors due to aging generators and poor maintenance of equipment at existing plants (plus low-quality coal in many cases); and loss of power due to poor-quality transmission lines and Transmission and Distribution losses.

Renewable energy: an appropriate alternative

Out of the above installed power generation capacity, renewables constitute only about 1 per cent of the installed capacity today. Though the per capita energy consumption is one of the lowest in South Asia, the energy intensity is one of the highest. The energy intensity, measured as the total energy use per unit of GDP, in case of South Asia is about 0.65 toe per thousand US dollars as compared to the world average of 0.29. Another critical issue in this region is that of access to energy. Large portion of the population does not have access to commercial energy sources and is dependent on traditional biomass. Similarly, though there has been growth in the installed capacity, a large population of about 60 per cent in the region still does not have access to electricity as shown in table 20.

This puts additional stress on the already insufficient energy resource base, making Sri Lanka the highest importer of energy in the region. Commercial and technical electricity losses are high in the region, often in excess of 40 per cent. In Sri Lanka, it is as high as 64 per cent.

Net energy import of the region amounts to 15 per cent of commercial energy use, ranging from 11 per cent in the case of Nepal to 47 per cent in the case of Sri Lanka in 2003.

Measures to increase energy security

Sharing resources

Energy security is another issue that needs to be addressed. This becomes possible through the creation of a South Asian energy market and cooperative development of the available diverse energy sources in the region. Such an approach can subsequently contribute to achieve a sustained high economic growth.

Table 20. Level of Electrification in South Asia

Country	Electrification (%)	Population without electricity (million)
Bangladesh	20.04	104.4
India	43	579
Nepal	15.40	19.5
Pakistan	52.90	65
Sri Lanka	62	7.4
South Asia	41.55	775.3
World	72.8	1644.5

Source: IEA 2002

South Asia's oil imports are projected to become more than double by 2020. The Middle East has been and is expected to remain the primary source of South Asian oil imports. In an effort to reduce oil import dependence, a number of South Asian countries have sought to expand domestic petroleum exploration by attracting private and foreign investors. In July 2003, the Sri Lankan government approved the Petroleum Resources Act to allow for private and foreign investment in its offshore oil and gas fields. Similarly, Pakistan recently executed Production Sharing Agreements (PSA) with exploration companies based in France, Malaysia and Austria. India is making attempts for better implementation of its 1997 New Exploration Licensing Policy (NELP) to increase foreign involvement in exploration, most recently by awarding 15 exploration blocks in February 2004.

Energy in rural areas

In South Asia, poverty alleviation is an issue of high economic development priority. The supply of reliable, sustainable commercial energy, particularly electricity to the rural poor households is critical to addressing this issue. With less than 25 per cent of the population having access to electricity in rural South Asia, the task ahead is gigantic. The huge rural population and the economics of South Asia constitute two main challenges facing access to electricity in rural areas. Successful models of rural energy practices are available, which can be considered for replication in other countries of the region. Regional cooperation can be an ideal framework for such cooperation.

Refining and transportation

In the face of the growing oil demand, several South Asian countries have responded with plans to expand their refining and transportation capacities. Since 1998, India's total refining capacity has increased by 86 per cent to 2.1 million bbl/d as of January 2004. In the face of the growing oil demand, several South Asian countries have responded with plans to expand their refining and transportation capacities. Since 1998, India's total refining capacity has increased by 86 per cent to 2.1 million bbl/d as of January 2004. While one of the private sector players, in India, has a capacity of 540 000 bbl/d, a public sector company plans to increase volumes, in a single refinery, from 180 000 bbl/d to 240 000 bbl/d by late 2004

In Pakistan, the 100 000-bbl/d "Pak-Arab" refinery came online in late 2000, helping to alleviate the country's dependence on refined product imports. Two additional planned refinery projects include a private venture near Karachi and an "Iran-Pak" partnership project near the border with Iran.

Box 21: Replicating a Practice from Denmark: Cooperatives

With cooperatives, people are able to do things that they could not do alone. They can buy, sell, and process food and materials on large scale. They can employ people with the skills they need. They can become independent of suppliers or services they find inadequate. During the last century, cooperatives have been crucial for the successful development of many of the richest countries of the world, such as the Danish farmer cooperatives that helped to establish Danish agricultural exports (Denmark is today the fourth richest country per capita). Cooperatives can be crucial for activities that private investors will not invest in because the profits are too small.



Cooperatives have proved to be successful over the years

Photograph: Development Alternatives

The cooperative movement

Cooperatives have been important in development of energy supply, owning power plants, electric grids and many other supply structures that a family or a small company cannot afford alone. This is the case in many countries of the world. Energy cooperatives to reduce poverty can include:

- ❖ Village cooperatives that establish small hydropower and mini grid.
- ❖ Village cooperatives to establish local power supply, e.g., from wood gasification, engine, photo voltaic (PV).
- ❖ Consumer cooperatives for maintenance, such as repair of PV and biogas installations.
- ❖ Farmer cooperatives that produce vegetable oil for transport (e.g. Jatropha oil) or bio diesel.
- ❖ Farmer cooperatives that produce fuel (e.g. charcoal briquettes) from agricultural residues.

To work successfully, cooperatives must be adapted to the societies they are part of and they must have the necessary skills and facilities for the types of businesses they are doing. In addition, they must have a leadership and a board of members that actively work for an efficient operation of the cooperative, aiming at the highest benefits for the members.

Source: INFORSE - Asia 2006

Natural gas

In January 2004, South Asia's proven natural gas reserves were estimated at 67.5 trillion cubic feet (Tcf), approximately one per cent of the world total, with potentially larger resources suspected but unproven. India's and Pakistan's reserves are roughly equal in size at 30.14 Tcf and 26.83 Tcf, respectively, while the only other South Asian country with reserves, Bangladesh, contains approximately 10.6 Tcf. The US Geological Survey estimates that Bangladesh contains 32.1 Tcf in additional "undiscovered reserves." If the higher estimates prove to be correct, Bangladesh could become a major gas producer and supplier to the potential market in neighboring India. Natural gas usage has increased rapidly in South Asia over the last decade, growing about 59 per cent between 1992 and 2002. In 2002, the region produced and consumed around 2.1 Tcf of natural gas. Around 42 per cent was consumed by India, 39 per cent by Pakistan, and the remaining 19 per cent by Bangladesh. The consumption of natural gas in India has risen faster.

Natural energy sources

At present, all natural gas production in South Asia is consumed domestically. Natural gas is seen as playing an important part in supplying new power plants in the region and diversifying from expensive oil imports. As a result, its demand is more than that of any other fuel in recent years and accounts for approximately 6.5 per cent of the country's energy demand. At nearly 0.9 Tcf in 2002, Indian gas demand is projected in the International Energy Outlook 2004 to significantly and rapidly increase, reaching 2.5 Tcf in 2025. Increased use of natural gas in power generation will account for much of the change. Like India, Pakistan plans to increase the use of natural gas for future electric power generation projects, a move that will necessitate a sharp rise in production and/or imports of natural gas.

If long-term projections of rapidly increasing gas demand for South Asia are correct, the region will require significant increases in production and/or imports. Even with expanded production, however, increased consumption of natural gas in South Asia is constrained by the region's inadequate domestic infrastructure. Gas imports would require construction of infrastructure - either cross-border pipelines or liquefied natural gas (LNG) facilities - and their success would likewise hinge on the successful construction of domestic gas pipeline infrastructure. A number of such infrastructure projects have been proposed in India and Pakistan. Bhutan, the Maldives, Nepal, and Sri Lanka do not currently produce or consume any natural gas.

Subsidy reforms for sustainable development

The efficient production, supply and use of clean energy are vital for sustainable development. Subsidy reform can help support the three pillars of sustainability - economic, social and environment and countries can learn from each other's experience, enhance co-operation, as well as build common ground between all countries in order to further decisions. There is a social rationale for using energy subsidies, though, subsidies should be phased out to promote more efficient market decisions.

While energy subsidy reform is expected to have a positive impact on the economy, it promotes inefficiency and excessive consumption. Energy subsidy systems should consider access to energy and basic living requirements; since, in developing countries, they are put into place with the intention to assist the poorest, however, they often fail to reach their target and are benefit richer categories. Hence it is important to carefully defining the target population groups and use effective delivery systems for their benefit. Restructuring should include tariff rationalization as well as attraction of investment. The availability of energy resources should take into account national and local circumstances, including geographical distribution of population. Strategies for reform should also take into account economic, institutional, informational, technological and political components.

Environmental issues are closely linked to energy subsidies and over-consumption of non-renewable energy, in most cases, leads to climate change impacts, sea level rise, damages to forests and bio-diversity and health problems. On the other hand, subsidies can benefit the environment when they are directed to renewable energy or to more efficient use of energy in general.

There is a need to utilize more efficient technologies, especially renewable energy. Renewable energy sources/ technologies offer a large range of solutions to increase production and distribution of clean energy, especially in remote rural areas. However, due to large investments that are required, targeted subsidies are often necessary for their development and deployment.

Comprehensive policy packages were needed and these should include subsidies and green taxes; cross-subsidies; reduction of import duties and low rates of interest on loans; and research and development. Public awareness needs to be enhanced on the real price of energy sources and their socio-economic and environmental impacts, as well as on ways to reduce negative effects.

There is a lack of data and information on the issue and further studies are required to clearly assess the quantity and effectiveness of energy subsidies as well as the impacts of past energy subsidy reforms in other South Asian countries.

Box 22: An Alliance to Advance Renewable Energy Usage

UNDP and the Government of Maldives have signed a four-year project on renewable energy, worth a total of USD 2.7 million. The goal of the project is to reduce the growth rate of greenhouse gas emissions such as carbon dioxide. The project will measure and assess the available renewable energy resources in the country and will promote the widespread use of renewable energy technologies. It will work to make the financial, marketing, technical and regulatory environments friendlier towards the development and use of renewable energy resources.

Currently, electrification needs of the country are met through diesel power generation, either by STELCO, the Island Development Committees or private power generators. There is some utilization of the renewable energy applications, but these are limited to solar energy systems for navigation, communication and water heating. Maldives is expected to continue to rely on imported fuels to meet most of its energy needs. However, some renewable energy resources such as solar and wind energy, as well as landfill gas, are recognized as potential alternatives as they are locally available, have minimal environmental impacts and contribute to improved provision of services to remote island communities.

By the end of the project, the use of renewable energy systems to meet both the electricity and non-electricity needs of the country is expected to increase significantly.

Source: UNDP 2004

There is the need to take into account the indirect impacts of international energy prices increase on all sectors of the economy. A transparent cost accounting system should be developed to allow reliable cost and benefit comparisons between renewable and non-renewable energy resources.

Renewable energy promotion

Utilization 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 would be worthwhile to look for cooperation and joint efforts between different countries for exchange of expertise and technologies within the region.

Biomass (non-commercial fuels)

As is the case in many developing regions, South Asia continues to rely heavily on biomass (i.e., animal waste, wood, etc.) for residential energy consumption, particularly in rural areas. According to the International Energy Agency (IEA), biomass accounted for about 80 per cent of residential energy consumption in 2000 and will account for 70 per cent of total residential energy consumption by 2020. Because the primary end uses of biomass are cooking and heating, the expansion of electricity access, used primarily for lighting, is not expected to have a significant affect on biomass use in the near future.

Rational 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, SEBs charge a maximum of Rs 2.00 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.

Collaborative efforts: South Asian Energy Alliance

A common grid would allow for greater investment in 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).

Sharing of energy and other natural resources may be considered for the mutual benefit of collaborating nations. While some suggestions have been discussed over the years, the initiative to set up a South Asian Energy Alliance needs to be taken by SAARC.

Subregional sharing of energy, besides rationalising peaks, can reduce costs and demand for power. For example, Pakistan has surplus power while Bhutan and Nepal have not harnessed their energy potential. On the other hand power deficient India and Bangladesh can make investments in Bhutan and Nepal to generate hydropower which is cheaper and cleaner than coal based thermal power.

South Asia is also well endowed with renewable sources of energy including wind, hydro, biomass and solar energy which offer the high potential for power generation. They could help address the problems of depleting fossil fuel resources and emission of greenhouse gasses. Regional cooperation will be relevant in sharing of technologies, expertise and investments.

References

Anon (u.d.) *Status of Renewable Energy and Energy Efficiency (REEE) in South Asia*

EIA (2004). *International Energy Database*. Energy Information Administration. <http://www.eia.doe.gov/emeu/cabs/bhutan.html#back>

Independent South Asian Commission on Regional Poverty Alleviation (2003). *Our Future Our Responsibility, Road Map Towards a Poverty Free South Asia*. Report of the Independent South Asian Commission on regional poverty alleviation.

INFORSE - Asia (2006). *Sustainable Energy Solutions to Reduce Poverty in South Asia*. The International Network for Sustainable Energy. http://www.inforse.dk/asia/P_successes_practices.htm

SACEPS (u.d.). *Energy Cooperation in South Asia*. Task Force Report. South Asia Centre for Policy Studies

UNEP (2001) *State of Environment South Asia 2001*, United Nations Environment Programme

Vladislav Vucetic (2004). *South Asia Regional Energy Trade: Opportunities and Challenges*. Annual Meetings, Washington, D.C., October 1, 2004. The World Bank/International Monetary Fund

UNEP (2001) Report of the Workshop on Energy Subsidy Reform and Sustainable Development: Challenges For Policy Makers, Bangkok, Thailand, 16-17 January 2001. http://www.uneptie.org/energy/Act/pol/wokshops/bangkok/docs/bangkok_report.doc

UNDP (2006). Press Release. United Nations Development Programme.



More investments in transmission and distribution across countries will lead to improvements in the region

Photograph: Atif Gulzar

Managing Urbanization



South Asia is experiencing a major demographic transition. During the last fifty years, India's total population more than doubled, while the urban population grew by more than five times. South Asia's expanding urban areas face a complex set of challenges that must be overcome if they are to fulfil their potential as hubs for economic, social and political innovation and leadership.

Spiralling population growth rates

The challenges are particularly great because of the speed at which their populations are growing (Table 21). In 1996, the urban population in Bangladesh was 23 million. By 2020, it will increase to 58 million. The urban population in Nepal, during the same period, will grow from 2.6 million to 7.7 million (SACOSAN-2).

The growing urbanisation has led to unchecked construction of houses without integrating environmental aspects related to siting, construction materials, etc. The demand of the construction sector on natural resources leads to injudicious extraction from rivers, quarries and clay pits.

There is poverty, inadequate food and shelter, insecure tenure, physical crowding, poor waste disposal, unsafe working conditions, inadequate services, overuse of harmful substances, and environmental pollution. Unsustainable use of natural resources and environmental destruction pose grave threats to urban productivity and restrict future development options.

Table 21: Urban Population as a Percent of Total Population

Units: percent

Country	1995	2000	2005	2010	2015
Afghanistan	19.9	21.9	–	27.2	30.5
Bangladesh	21.5	23.2	25.0	27.1	29.6
Bhutan	6.5	7.7	9.1	10.8	12.6
India	26.6	27.7	28.7	30.3	32.2
Maldives	25.6	27.5	29.7	32.3	35.2
Nepal	11.0	13.7	15.8	18.0	20.5
Pakistan	31.8	33.1	34.8	36.9	39.5
Sri Lanka	21.2	21.1	21.0	21.5	22.5

Source: UN 2004

The pressures caused by geometric population growth, continue to create huge environmental, health and infrastructural problems. This can, in turn, lead to social unrest.

Impacts

Urbanization, no doubt, has led to increased productivity and economic diversification, but has also caused deprivation, poverty, and marginalization. Environmental problems include those caused by widespread poverty, industrialization, and a change in consumption patterns. The cumulative impact of these two causes has serious effects

Box 23: Human Development

One way to evaluate the progress in the region in terms of development is by measuring the Human Development Index.

The Human Development Index (HDI) is a comparative measure of life expectancy, literacy, education, and standards of living for countries worldwide. It is a standard means of measuring well-being, especially child welfare. It is used to distinguish whether the country is a developed, developing, or an under-developed country, and also to measure the impact of economic policies on the quality of life. It attempts to describe the achievement of development goals related to the quality of life, using data that can be compared across countries and used for creating time-series.

HDI values have shown an increase in all regions of South Asia, being highest for Maldives and least for Bangladesh and Nepal. HDI values have shown an increase in all regions of South Asia, being highest for Maldives and least for Nepal and Pakistan.

Table 22: Human Development Index

Units: Index: 0-1, higher number indicates more developed

Country	2000	2002	2004
Bangladesh	0.5	0.51	0.53
Bhutan	..	0.54	0.54
India	0.58	0.6	0.6
Maldives	..	0.75	0.74
Nepal	0.49	0.5	0.53
Pakistan	..	0.5	0.54
Sri Lanka	..	0.74	0.76

Source: UNDP 2006

on urban dwellers, Noise, overcrowding, inappropriate design, and stress contribute to the growing psychosocial health problems of many urban dwellers in developing countries.

Squatter settlements

Urban populations in south Asia are expanding rapidly, placing enormous pressures on urban services. The proportion of urban residents living in slums is high and continues to grow. In many Indian states with large shares of urban population, for example, Maharashtra (38 per cent), Gujarat (34 per cent), and Tamilnadu (34 per cent), the share of urban population below the poverty line is greater than in rural areas. According to the World Bank, more than 50 per cent of Indian urban dwellers live in slums and squatter settlements and these areas grow at twice the rate of urban areas. Nepalese and Sri Lankan urban dwellers seem to be doing slightly better, with 19 per cent and 28 per cent of their urban populations falling below the poverty line respectively.

In Afghanistan, Bangladesh, Nepal and Pakistan more than 70 per cent of the urban population resides in the slums (Table 23), which are poorly equipped to meet the basic needs of water and sanitation of the dwellers. This results in people falling prey to various diseases and putting additional strain on the healthcare facilities in the area.

Low incomes, illiteracy, and inaccessibility to development opportunities further complicate the problems. Slum dwellings have no ventilation or

Table 23: Percent of urban population living in slums

Units: Percent

Afghanistan	98.5
Bangladesh	84.7
India	22.58
Maldives	0.0
Nepal	92.4
Pakistan	73.6
Sri Lanka	13.6



An increasing number of squatter settlements is putting considerable pressure on infrastructure

Photograph: Stefan Karpinski

Source: UN-HABITAT 2003

natural light and are most vulnerable. They suffer from dust, smoke, and noise pollution. Piles of garbage, potholes, stray animals, flies, and mosquitoes are a common sight in slums.

Water and sanitation

Access to improved water sources to urban populations varied from 82 per cent in Bangladesh to 98 per cent in Sri Lanka in the year 2004. (Table 24) However, the actual quality of the water changes considerably from season to season. Sewage service coverage is well below that for water supply.

Table 24: Water and Sanitation: Urban Access to Improved Water Sources

Units: Percent (%)

Water			Sanitation		
Country	1990	2004	Country	1990	2004
Afghanistan	10	63	Afghanistan	7	49
Bangladesh	83	82	Bangladesh	55	51
Bhutan	..	86	Bhutan	..	65
India	89	95	India	45	59
Maldives	100	98	Maldives	100	100
Nepal	95	96	Nepal	48	62
Pakistan	95	96	Pakistan	82	92
Sri Lanka	91	98	Sri Lanka	89	98

Source: WHO; UNICEF 2006

Lack of basic amenities

Less than half the urban population in India has access to adequate toilet facilities, and sewage treatment is virtually nonexistent, creating one of India's most serious environmental problems - surface and ground water contamination. The situation is virtually the same in Bangladesh, Nepal and Sri Lanka.

This problem is more pronounced amongst the slum dwellers. Very few slums have access to potable water and sanitation services. Children living in slums are more vulnerable to diseases and deficiencies than their rural and other urban counterparts.

Urban air pollution

The majority of South Asian cities suffer from extremely high levels of urban air pollution, particularly in the form of small suspended particles. Region-wise, urban air pollution is estimated to cause over 250 000 deaths and billions of cases of respiratory illnesses every year (World Bank 2006).

The cities and countries in South Asia differ in terms of the level of air pollution, level of urbanization, size of the population exposed, fiscal regime, fuel and other supply infrastructure, availability of natural gas (a clean fuel), and the resources and institutions available to carry out air quality management. It is, therefore, understandable that South Asian governments have followed different paths in addressing air pollution. India leads the region in tackling local air pollution for a number of reasons: it has a number of large population cities with high levels of air pollution, a significant presence of refining and vehicle manufacturing industries, a long history of air quality monitoring, and a

number of very active and well informed environmental non-governmental organizations (NGOs) raising public awareness, collecting and analysing data, and challenging the government to play a more active role. It is the only country in the region with an emissions' laboratory that is certified to measure mass emissions for vehicle certification.

Available air quality data suggest that the pollutant of most concern from the point of view of environmental health risk in South Asia is airborne particulate matter. Where measurements are available, alarmingly high concentrations have been recorded in Bangladesh

Table 25: Passenger cars per 1 000 people

Country	1990	2000	2003
Bangladesh	0.4
India	2.4	5.9	..
Maldives	3.8	..	5.1
Pakistan	4	8.1	..
Sri Lanka	6.5	12.6	..

Source: World Bank 2006

(Dhaka), India (large cities), Nepal (Kathmandu), and Pakistan (Karachi, Lahore, and Rawalpindi). The ambient particulate concentrations are moderately elevated in Sri Lanka (Colombo), and in Bhutan to curb air pollution, the government has adopted/introduced vehicular emission standards and the Industrial Emission Standards.

Costs to society arising from urban air pollution include damage to human health, buildings, and vegetation; lowered visibility; and heightened greenhouse gas emissions. Of these, increased premature mortality and morbidity are generally considered to be the most serious consequences of air pollution, both on account of their human and economic impacts. It is common and appropriate, therefore, to use damage to human health as the primary indicator of the seriousness of air pollution.



More persons are travelling by cars, thereby leading to increased air pollution in cities

Photograph: istockphoto.com

Countering urbanization pressures

South Asian cities are drowning in their own waste. Due to a continued high population growth and economic development in urban areas, many public, private as well as informal service providers in cities are unable to cope with the increasing volumes of solid waste, especially in poor and low-income settlements. Regular and safe disposal of solid waste is the basis for settlement hygiene and prevention of diseases and hence, the foundation for any development activity aimed at poverty alleviation.

Solid waste management

In New Delhi and Mumbai, more than 1.5 tons of garbage is left rotting on the streets or in improperly maintained pits every day. Dhaka is only able to collect about 50 per cent of its waste each day. Further, since the city of Dhaka is growing so quickly, dumpsites must be located further from the Dhaka centre, making it more costly to haul the garbage out of the city. Kathmandu faces similar challenges. Almost the entire urban and suburban population of Sri Lanka, except a part of Colombo, is dependent on on-site systems for sewage disposal. At present the sewage handling system in the Colombo municipality area which dates back to the colonial period has reached its full capacity and requires urgent investment. Similar investments are required even in most other urban centres across the country. The solid waste presently collected by the municipal councils is generally dumped openly without proper management, due to high costs associated with proper dumping sites, substantially damaging the environment. The municipal waste collection, which was about 2,560 tons per day in 2000, is projected to increase to about 2,885 tons per day by year 2010 and therefore the environmental problems associated with it will intensify.



A cow is picking through a smoking heap of rubbish

Photograph: istockphoto.com

The piles of garbage that clog street drains in South Asian cities contribute to floods during the rainy season, which seriously jeopardize the health of nearby residents.

Most of the times, the metropolis lacks the capacity to collect and process more than a small proportion of its sewage and garbage. The rural migrants eventually adapt to the requirements of life in the city, but it is not so certain that the cities will be able to adapt to the influx of rural migrants and to the lack of financial resources needed to confront the severe existing and future problems.

Box 24: Recycling Waste in Namakkal, India

Namakkal is a town in Tamil Nadu, which is situated on the highway from Salem to Dindigul. It is the first municipality in the country to privatize all the components of solid waste management. By the institutionalization of door-to-door collection with segregation at source; vermicomposting and sale of recyclable waste from inorganic waste, Namakkal has the distinction of being the only zero garbage town in the country. In order to achieve this, they follow a ten point charter:

1. Extend the scheme of door-to-door garbage collection (with segregation) to the entire town and make the streets and roads garbage free.
2. Introduce night sweeping at bus stands and important roads, etc., and maintain cleanliness round the clock.
3. Extend the scheme of door-to-door garbage collection and sweeping on holidays and Sundays.
4. Make the parks and burial grounds beautiful and attractive through NGOs and voluntary agencies.
5. Remove encroachments on all roads and streets.
6. Prevent road-side hotels, lorry repair shops, etc., on the national highway and plant trees.
7. Remove pigs and dogs from the town.
8. Levy service charges on hotels, Kalyanamandapams (or wedding spots), commercial complexes and garbage generating industries.
9. Manufacturing of vermi-compost from organic waste through voluntary organizations / private agencies on B.O.T. basis, sell the inorganic recyclable garbage and convert the compost yard into Nandanvanam.
10. Engage two 'mop-up' teams with two auto model carriers to remove the waste then and there, round the clock, and make the town garbage free.

This experiment has been successful due to its holistic approach, with all the agencies cooperating, under the leadership of the District Collector. The committee includes the district administration, the municipality, a consortium of NGOs, women self-help groups, schools, market associations, industrial associations, RWAs and



rag pickers. Although Namakkal is a small town, with a population of 60 000 to 70 000, it has two major industries - body building of 60 per cent of CNG tankers in the country and a very large and well-organized poultry industry. Hence, if no effort was made, the town would have virtually turned into a garbage dump. Now awareness has been created and every citizen accepts the responsibility of keeping the town clean and ensuring that nothing is thrown anywhere except in a bin.

Source: DA 2005

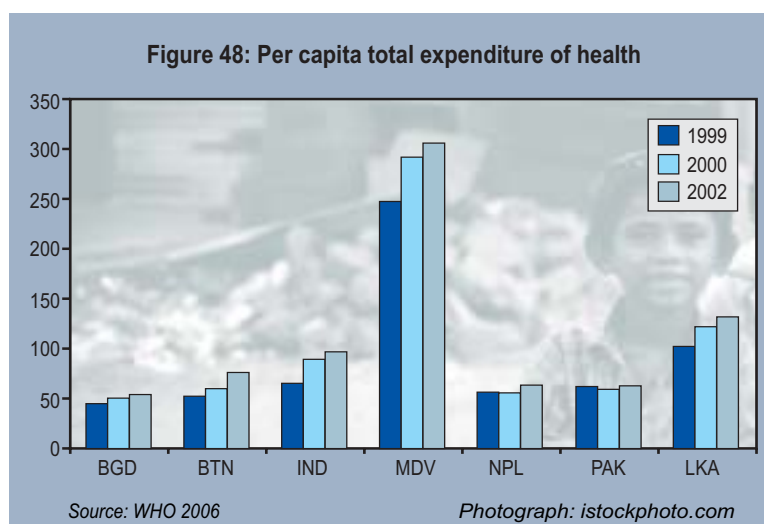
The Ministry of Environment & Natural Resources, Govt. of Sri Lanka has taken initiatives to implement various strategic priority programmes to address current challenges in the environment and natural resources sector in Sri Lanka. "Pilisaru Waste Management Programme" has been initiated to establish a platform to bring all relevant stakeholders together to implement a cohesive national programme to address waste management issues in the country.

Integrating healthcare into development

As the pace of urbanization increases, the new challenges for health and development become more critical. So, recognizing the significance of urban health in the changing context, many initiatives are in place at national and international levels to address the emerging health problems in the growing cities. Urban health programs need to focus on the urban poor with health, education and services. Social protection program is another important opportunity to improve the urban health. The local bodies can identify the poor and their health needs in a participatory and gender-sensitive approach, which can be a useful link to develop appropriate policies and strategies.

Per capita expenditure on health was highest for Maldives at US\$307 per person per year, followed by Sri Lanka at US\$131 per person per year, and lowest for Bangladesh at US\$54 dollars per person per year (figure 48).

Urban health problems arise due to food insecurity; malnutrition; overcrowded and unhygienic living conditions; pollution and lack of safe drinking water and sanitation. Migration leads to the spread of many communicable diseases. People may encounter diseases in the urban areas due to unsanitary conditions of temporary dwellings i.e. slums. Furthermore, it is found that there are occurrences and distribution of a wide range of infectious diseases in urban slums such as tuberculosis, hepatitis and pneumonia. This has potentially wider impacts on life style, quality of housing, and diet or nutrition. This may cause new disease patterns in the urban areas. Plastic and polythene bags, rotting food, paper, cloth, animal bones, cans, and glass are found in garbage piles in most of the cities.



Healthy cities require safe, easily accessible, and affordable water, sanitation, safe home and working environments. Health information, education and communication services must be expanded to promote healthy life styles.

The health of the urban poor is often worse than that of their rural counterparts. Child mortality rates among populations in the lowest income quintiles, for example, are higher in urban areas than in rural areas. Children from poor families who live in urban areas are also more likely to be underweight and experience stunted growth than their rural counterparts. Air pollution is another important health challenge for urban residents in South Asia. In Delhi, one out of ten school children have asthma. According to a World Bank- Asian Development Bank study, premature deaths due to air pollution in Indian cities were estimated to have increased by 30 per cent between 1992 and 1995. High levels of lead pollution in the air lead to the stunted growth in children as well as hyperactivity and brain damage.

Population control: information is the key

Any discussion on 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 consume a large portion of the already limited amount of resources available is still far from being perceived as it should be. Both in terms of primary resources (such as fuel

wood, 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.

However, the root of all evil is the lack of awareness about the severity of the poverty problem at all levels, 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.



Poverty is a fall-out of over population

Photograph: istockphoto.com

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

Collaborative efforts

The general plan for the South Asian region, based on the experiences of the member countries, emphasizes 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 food grains is emphasized for sustainable poverty reduction.

Sustainable livelihoods

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 has also been slow, despite substantial government efforts and resources that included allocating about a fourth of the annual development budget to social infrastructure.

Micro-enterprises

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 the 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 the medium and large-scale industries. NGOs, set up to assist small-scale industries, can play a key role here.

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 privatizing state-owned enterprises has been slow.

Substantial state-owned enterprise losses continue to drain the budget, consuming funds that could otherwise be used

for poverty reduction. The sub-region is still unable to exploit its full potential in terms of economic growth. 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.

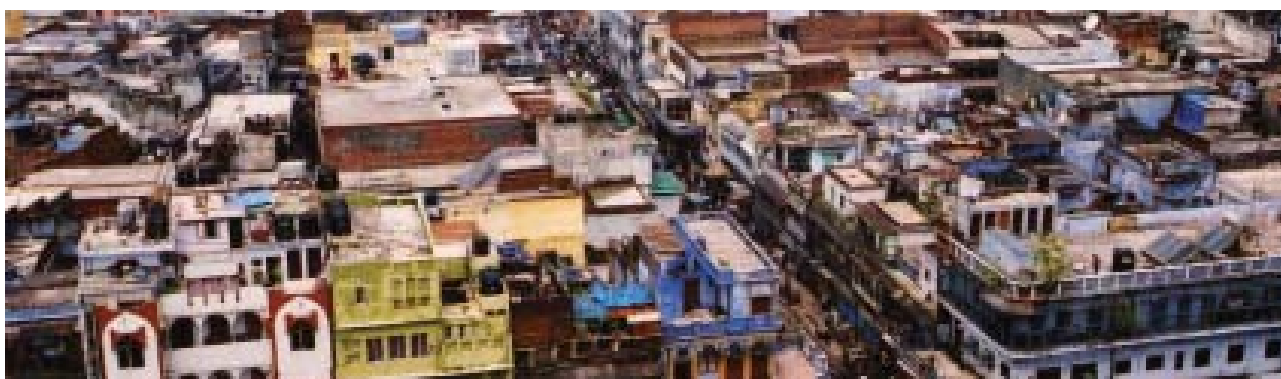
Hazardous waste management

ADB has committed grants worth US\$400 000 to four South Asian countries to improve their management of hazardous waste. Targeted at Bangladesh, Bhutan, India, and Nepal, the technical assistance (TA) project will help assess hazardous waste problems, draft policy rules to manage waste, and report on the potential for private sector involvement.

It is envisioned that Bhutan, Bangladesh, and Nepal will benefit from India's experiences in regulating waste. Ultimately, the four countries should be able to come up with compatible rules on managing hazardous waste. It may also be one day feasible to have common treatment facilities". The project will help strengthen cooperation between the four countries, through the sharing of knowledge and identifying ways to use common facilities for safely treating, transporting, and disposing of hazardous waste (UNEP RRC.AP).

References

- Bhandari J. (2006.). *Urban Health Challenges and Opportunities*. One World South Asia.
- DA (2005). Solid Waste Management - The Namakkal Experience. *In* Newsletter, June 2005. Development Alternatives.
- ESMAP (2004). *Toward Cleaner Urban Air in South Asia: Tackling Transport Pollution, Understanding*. Joint UNDP/ World Bank Energy Sector Management Assistance Programme.
- Independent South Asian Commission (2003). *Our Future Our Responsibility, Road Map towards a Poverty Free South Asia: a Report*. Independent South Asian Commission on Regional Poverty Alleviation,
- Our Health (2006). The South Asian Urbanization, Slums. *Our Health*.
- UNEP (2001). *State of Environment South Asia 2001*, United Nations Environment Programme.
- UNEP RRC.AP (u.d). United Nations Environment Programme Regional Resource Centre for Asia-Pacific. <http://www.rrcap.unep.org/>
- USAID (2006). *Making cities work*. United States Agency for International Development.
- World Bank (2006). Development Data Group. The World Bank
- WHO (2006). World Health Report 2006: Annex Table 3. World Health Organization, Geneva. Available online at: <http://www.who.int/whr/2006/annex/en/index.html> and in the WHO Statistical Information System (WHOSIS): Core Health Indicators



Urban population in South Asia has grown over five times in 50 years

Photograph: istockphoto.com



Policy and Institutional Options

To address environmental challenges in South Asia, it is essential to focus on diverse response options and instruments for possible solutions. Emphasis must be placed on increasing responsibilities of all stakeholders and more cooperative efforts towards ensuring a healthy environment in future. Increased awareness of ecosystems and new market based systems will prove to be important mechanisms in dealing with environment issues.



Building Awareness

Countries in South Asia recognize the immense sustainable development challenges and the vital role that environmental education can play in overcoming these. (News Environment Education 1997). Spreading awareness and empowering people to take decisions, at the local level, is an effective way of dealing with the environmental problems of South Asia. Their decisions will enable initiatives that benefit themselves, as well as the local environment. It has been seen that solutions always emerge whenever governments involve people, using a participatory approach, to solve problems.

Centuries of careful tending of land on which people depend, is an example of their ability to coexist, harmoniously, with nature; and each generation has passed on its traditional understanding of managing natural resources to those who have followed. In many nations of the region, religion too, has a bearing on people's relationship with the environment. For example, Buddhist philosophy advocates environmental protection and prevention of environmental disturbance.

Rapid population growth is a major challenge which South Asian countries face. Education and awareness; better health facilities; accessibility to birth control methods and promoting a woman's right to exercise her decisions are the obvious solutions. The quickening pace of development, industrialization, urbanization and population growth is challenging traditional practices. The use of medicinal plants, organic farming and traditional arts and crafts (the use of vegetable dyes for dyeing clothes) are being lost in the globalization process. Farmers need to be educated about better and more sustainable agricultural practices.

Wasting resources is a practice common to affluent sections of society and 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 in rural areas. In developed nations recycling industries are firmly in place to withstand high consumption pressures. In South Asia, especially in urban centres, the concept and practice of recycling is not common. Awareness needs to be spread so that individuals understand the value of conserving resources (water, energy) and products (food), especially among affluent



For a greater sustainability stakeholders should educate the local population for proper leveraging of resources

Photograph: Development Alternatives

sections of the population.

Another major challenge is conserving the rich biodiversity and using it sustainably for the economic benefit of the region. Local populations should be educated about the natural wealth they possess, so that the developed world does not take undue advantage of their traditional knowledge, by patenting it, for example. Governments can work in cooperation with local communities to document the knowledge for posterity and as a step towards protection against unfair patents.

Protecting traditional knowledge and practices

The South Asian region has a rich diversity of plants, which have been used by people for generations. The majority of people in this region still rely directly on preparing the document for diversity of plants, or plant genetic resources, for food and medicine. There is an abundance of local expertise in plant genetic resources that has been in use over a considerable period of time and is also constantly evolving. In agriculture, for instance, this knowledge is shown in the development and adaptation of plants and crops to different ecological conditions (soils, rainfall, temperature, altitude etc.). Traditional knowledge is people's awareness and understanding of this and other information, which is passed on from one generation to the next, usually by word of mouth or example within a specified group of people.

Intellectual property rights

Most of the debate about traditional knowledge at the international level is taking place in the context of Intellectual Property Rights (IPR). It is through IPR, and particularly patents, that control and ownership over traditional knowledge is being usurped by commercial interests

It is clear that industries, with increased support from governments, are quickly establishing control over plant genetic resources and associated knowledge through the use of IPRs. Yet resistance to this incursion on community rights has been disparate and experimental. Overall, communities are increasingly losing control over their own plants and are being increasingly exploited for their knowledge. As awareness amongst groups, communities and even governments increases, and as those affected become more organized, the tide has begun to turn. There is however a lot of strategic work to be done among NGOs and people's movements in order to build a stronger social force against the growing influence of trade and IPR over genetic resources and traditional knowledge.

Concerns have also been raised that the biological resources on which traditional knowledge flourishes on now also face the threat of depletion. Plants are vanishing so quickly that the Earth is losing one major drug to extinction every two years. Disrupting the interrelation between the traditional knowledge-generators and their resource, may well lead to the disintegration of the very processes by which the knowledge evolved and is kept alive.

Empowering local communities

With countries in the region facing and succumbing to such threats of biopiracy and breach of IPR's, a collective stand may provide an effective sharing of traditional knowledge. Steps which could be taken to address these threats include:

Networking: increased networking amongst NGOs and communities to present a united body of opinion.

Community rights: the development and establishment of strong community rights' systems that recognize the collective nature of local innovation promote its development and application; encourage



Communities who are losing control over plant genetic resources and must be protected against exploitations

Photograph: istockphoto.com

individual innovation within this community framework, and shield biodiversity and indigenous knowledge from privatization.

Legal rights: conferring clear and unambiguous legal rights to genetic resources, this is closely linked with the recognition of the rights of indigenous peoples and local communities to such resources. This means that basic issues of self-determination, sovereignty and communities' own definitions of their rights need to be dealt with and built into statutory law and policy at national level.

Documentation: the recognition and protection, through legal means, of the various initiatives at documenting traditional knowledge. The uncertainty about whether and how to document the materials and knowledge, for fear that the information is used against the people's interests, needs to be resolved.

Alternative approaches: examining and highlighting alternatives to IPRs which protect traditional knowledge.

Trade-related aspects of intellectual property rights: strengthening a unified demand to review and amend the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights.

Environmental education

The dissemination of awareness and education about the environment can be done both, 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. Academic approaches have included separating environmental studies from other courses or incorporating it into existing curricula at the primary and secondary levels. Many schools have organized and established eco-clubs, whose members participate in 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 polythene bags, planting trees, etc.).

Formal education is often, supplemented through activities carried out such as visits to field study centres, museums and parks, use of audiovisual 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.

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 participation of people. Efforts, therefore, have been made through campaigns to create in the people - a concern for and awareness of the environment.



Bamati rice is one of the cereals where control and ownership is being usurped by commercial interests

Photograph: istockphoto.com



Civil society is facilitating environmental education among groups, especially women

Photograph: Development Alternatives

The Ministry of Environment & Natural Resources, Govt. of Sri Lanka has taken initiatives to implement various strategic priority programmes to address current challenges in the environment and natural resources sector in Sri Lanka. “Haritha Niyamu” programme is one such programme conducted by the Central Environmental Authority (CEA). CEA conducts awareness and educational programmes at various levels targeting school children, teachers and community at large to secure their participation in environmental conservation.

Currently India is preparing State of Environment Report of India for mainstreaming Environment in decision making and also for spreading environmental awareness at National and State level.

The recommendations for making environmental awareness more effective at a formal level are:

- ❖ 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.

Table 26: Some innovative environmental education (EE) activities undertaken in South Asia.

Country	Responsible Organizations	Innovative practices
Bangladesh	Ministry of Education; Ministry of Environment and Forests	<ul style="list-style-type: none"> ❖ Grades 3 to 5 have courses in Environmental Studies (Society) and Environmental Studies (Science). Teachers' guides have been developed for these courses. ❖ The National Environment Policy and National Plans have emphasized the importance of EE. ❖ Environmental themes are infused in Grades 1 and 2 and are integrated in Grades 3 to 8. Separate courses have been developed at the tertiary level. ❖ Universities offer courses such as Zoology, Botany and Geography with environmental themes. ❖ 400 science clubs have been established in schools across the country.
Bhutan	Ministry of Health and Education; National Environment Commission	<ul style="list-style-type: none"> ❖ Bhutan has developed a new approach to its primary education curriculum (up to Grade 3). This approach is called EVS (Environmental Studies) and emphasizes conservation and sustainable uses. In view of the considerable success in pupils' achievement levels, EVS has been extended to other levels. ❖ New courses such as Physical Education, Health and Creative Arts also include environmental themes. ❖ Informal nature group centres have been established to educate local villagers.
India	Ministry of Human Resource Development; Ministry of Environment and Forests	<ul style="list-style-type: none"> ❖ The National Conservation Strategy and Policy Statement has emphasized the importance of EE. ❖ A Supreme Court order has required the University Grants Commission to prescribe courses on the environment in higher education. ❖ A composite course is given to Grades 1 to 2 and Environmental Studies-I (Social Science) and Environmental Studies-II (Science) courses are taught in Grades 3 to 5. ❖ Grades 1 to 5 emphasize learning in, about and for the environment.

Country	Responsible Organizations	Innovative practices
		<ul style="list-style-type: none"> ❖ A 9-month professional training course on EE is provided to post-graduate students. ❖ The Prayavaran Vahini Scheme is underway to create environmental awareness. ❖ In-service and pre-service training are provided to teachers and civil servants. ❖ The ENVIS (Environmental Information System) has been established to collect, retrieve and disseminate environmental information. ❖ A National Environmental Awareness Campaign (NEAC) has been initiated for public awareness. ❖ Some 3500 eco-clubs are actively run across the country for Grades 6 to 10.
Maldives	Ministry of Education; Ministry of Home Affairs, Housing and Environment	<ul style="list-style-type: none"> ❖ The 2nd National Environment Action Plan emphasizes environmental awareness. ❖ A President's Environmental Award Scheme has been established for schools. ❖ Grades 1 to 5 have Environmental Studies courses with teacher's guides and reference materials. ❖ Grades 8 to 10 have a Fisheries Science course. ❖ Environmental clubs are active in schools.
Nepal	Ministry of Education; Ministry of Environment, Science and Technology; Environment Protection Council	<ul style="list-style-type: none"> ❖ The National Conservation Strategy and the 9th Five Year Plan emphasize environment and EE. ❖ Grades 1 to 3 have an Environment Around Me course; Grades 4 to 5 have Environmental Science and Health Education; Grades 6 to 8 have Population and Environmental Education; Grades 9 and 10 have Health, Population and Environmental Science; and Grade 12 has Environmental Education. ❖ An EE course for a bachelor's degree program in education has been developed. ❖ Popular extracurricular activities include field trips, school visits, outdoor camps, competition and contests, and project work.
Pakistan	Federal Ministry of Education; Pakistan Environment Council; Federal Ministry of Environment	<ul style="list-style-type: none"> ❖ Pakistan has an Environmental Strategy and Education Sub-strategy for the Balochistan and Sindh provinces. ❖ Strategies have been developed for Mass Environmental Awareness and Education. ❖ The country has launched the Coordinated Environmental Education Project (CEEP) for training teachers and decision-makers. ❖ A course outline and teachers' manual have been developed for Environmental Studies as an optional secondary school course. ❖ The Karachi Institute of Environmental Studies offers an EE course in its master's degree program. ❖ The proposal of establishing a Teacher's Center for Excellence in EE in Islamabad has been approved.

Country	Responsible Organizations	Innovative practices
		<ul style="list-style-type: none"> ❖ The proposal of establishing a Teacher's Center for Excellence in EE in Islamabad has been approved. ❖ A prototype curriculum and teachers' manual for pre-service training programs have been developed. ❖ Several in-service EE training courses for governmental officials are organized. ❖ Special programs are run to "green" opinion leaders and religious leaders. ❖ The DEEP (Daudpota Environmental Education Program) Prize for outstanding work in EE has been established. ❖ A 16-week training course spread over a period of two years is run for government, NGO, business and military personnel under the LEAD (Leadership for Environment and Development) Program. ❖ Several hundred environmental clubs (nature clubs) have been established in schools nationwide.
Sri Lanka	Ministry of Education and Higher Education	<ul style="list-style-type: none"> ❖ A course Environmental Studies is offered at the primary level; Science, Social Studies and Health at the secondary level and Zoology, Botany and Geography at the senior secondary level. ❖ Environmental themes are incorporated into the bachelor's degree courses such as Zoology and Botany. ❖ Environmental modules are found in education programs for teachers. ❖ The National Education Commission requires schools to contribute to "the evolution of a sustainable pattern of living". ❖ Environmental topics have been integrated into primary and secondary curricula since the 1970s. ❖ Environmental Pioneer Brigades and Environmental Clubs have been established in schools. ❖ Field Study Centers have been established.

Source: IGES 2000

- ❖ Organize 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.

Some innovative environmental education activities undertaken in South Asia are briefly presented in Table 26.

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 are generally aware of their responsibility towards the environment (more so because the law keeps a close watch on them), smaller factories and workshops 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.

The critical role of 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, forestation, energy saving and water management do not provide learning opportunities for women. Therefore, women require better opportunities 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.



The role of women in rural areas enables them to understand conservation better

Photograph: Vasant Dave

Environmental communication

The essence of environmental communication is to convince people that there is a problem 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.

The role of media

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 focused 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 rural areas by using local languages to transmit 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."

Folk art

Communications through the folk media is an effective age-old technique. Experiments have demonstrated that people residing in rural areas respond most readily when communicators relate to their local circumstances and

cultures, and when they interact with the audience. A UNESCO study in Sri Lanka showed that storytellers 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 dramatization, and song-and-dance sequences - as applied successfully in Nepal, Sri Lanka and Ahmedabad, India (UNEP, 1985).

Recommendations

The recommendations for making environmental awareness more effective are

- ❖ Education and communication has, as a general rule, been always starved of funds. Financial allocations by governments for education are minuscule 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.
- ❖ Encouragement and support to NGOs for carrying out environmental awareness programmes.
- ❖ Formulate a comprehensive country-wide awareness programme through the print and audiovisual 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.

References

GRAIN; Kalpavriksh (2002). *Traditional knowledge of biodiversity in Asia-Pacific: Problems of Piracy & Protection*, Kalpavriksh Environmental Action Group and Genetic Resources Action International. www.grain.org/publications/tk-asia-2002-en.cfm

UNEP (2001). *South Asia: State of the Environment 2001*. United Nations Environment Programme.

Institute for Global Environmental Strategies (2000). Environmental Education in the Asia-Pacific Region: Some Problems and Prospects. *International Review for Environmental Strategies*. (1) No.1, pp. 57 - 77, 2000



Folk art is an effective means of communication in rural areas

Photograph: The Bamboo Store



Participatory Management

Community-based natural resource management initiatives coupled with policy reforms can prove an effective mechanism for improving access to, and improving productivity of natural resources. The success of joint forest management in India, hill community forestry in Nepal and irrigation user groups in India, Pakistan and Sri Lanka provide evidence that social capital and participatory processes are as crucial to environmental protection as financial resources and development programs. The value of human, land, water and other assets depend on technologies that improve the productivity of those assets thereby generating adequate return and income. Globalization can bring significant benefits of technological advancement, and market access through improved connectivity and information. However, it must be emphasized here that unless local communities themselves, are involved in the selection and use of these technologies, they are unlikely to benefit from their implementation and these technological interventions will be unsustainable in the longer term.

Research and development

In order to rapidly advance scientific understanding of environmental issues, it is necessary to promote focused research by competent institutions. A continuous engagement with the scientific community, in governments, academic, and private institutions, will provide important insights for policy making and regulation – including multilateral negotiations – and help utilize deeper and broader skills in the scientific community. Key areas of research are

- ❖ Taxonomies of living natural resources.
- ❖ Research leading to better understanding of ecological processes and pathways.
- ❖ Research which provides direct inputs to policy making.
- ❖ R&D in technologies for environmental management and clean production.

The order of priority of these research areas are very likely to change over time. Actions are necessary to periodically identify and prioritize areas for research; establish a research programme in priority areas within governments, with expected outputs clearly specified; and encourage research in priority areas outside governments with necessary financial and institutional support.

International cooperation

South Asian countries have contributed to, and ratified several key multilateral agreements on environmental issues in recognition of the transboundary nature of several environmental problems; and have complied with their commitments. They have also participated in numerous regional and bilateral programs for environmental cooperation. To enhance capacities to comply with commitments, and ensure sustained flows of resources for environmental management, the following steps should be taken:

- a) use multilateral and bilateral cooperation programs for capacity building for environmental management, particularly in relation to commitments under multilateral instruments;
- b) participate in mechanisms and arrangements under multilateral agreements for enhancing the flow of resources for sustainable development; and
- c) encourage cooperation among countries in the sub-region, in particular for scientific and technical capacity building in environment management.



Participatory approaches have proved successful in helping achieve the goals of sustainable development

Photograph: Development Alternatives

Global partnerships

Macro-partnerships can provide a global framework for development strategies, thereby enhancing effectiveness of investments and aid, through improved donor coordination. The Comprehensive Development Framework (CDF), proposed by The World Bank, provides a holistic approach to development and seeks a better balance in policy making by highlighting the interdependence of social, human, environmental, economic, institutional and financial elements. Similarly, the United Nations Development Assistance Framework (UNDAF) brings greater coherence, collaboration and effectiveness to UN development efforts. Though CDF and UNDAF are currently in the experimental phase, both mechanisms embody the bottom-up approach.

Regional mechanisms

The transboundary nature of global environmental problems suggests that cooperation between states, represents the best strategy for addressing concerns, effectively. It is suggested to setup a strong regional authority to coordinate biodiversity and solid waste management initiatives. Therefore, responding to environmental problems through prompt collective action could be an important means to generate trust and goodwill.

Even though there are several regional mechanisms for environmental protection, there exists a need for more policies that address the nature of transboundary environmental problems and their impacts. A network of regional institutions could be effective in complementing existing institutional mechanisms, by contributing to: the creation of a better understanding of key issues; exchange of information among key institutions; and training and capacity building of appropriate stakeholders. A proper perception on common environmental problems will result in common and politically compatible solutions, ensuring better cooperation between countries of South Asia.

References

- TERI (u.d.). *Environmental Security: A South Asian Perspective*. Tata Energy and Resources Institute, New Delhi, India
- MoEF (2006). *National Environment Policy, 2006*. Ministry of Environment and Forests, Government of India, New Delhi, India.



Technology Transfer

South Asia is facing one of the fastest growths of population, economic activity, as well as pollution. Transferring state-of-the-art eco-friendly technologies and training people to use them, is essential to meet this threefold challenge. The focus should be on the propagation and use of "green technologies" which include an evolving group of methods and materials for producing nontoxic clean products.

The term 'green technology' refers to comprehensive technology, which allows for prevention of pollution and restoration, of the damaged environment and promotes development while preserving the environment. 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 knowledge, processes, goods and services, facilities and organizations and management processes. The objectives are to:

- ❖ ensure sustainability by meeting the needs of society in sustainable ways without damaging or depleting natural resources;
- ❖ manufacture products that are nontoxic or biodegradable and be partially or fully reclaimed or reused;
- ❖ reduce waste and pollution by changing patterns of production and consumption;
- ❖ developing alternatives to technologies - whether fossil fuel or chemical intensive agriculture - that have been demonstrated to damage health and the environment; and
- ❖ create a centre of economic activity around technologies and products that benefit the environment, hasten their implementation and increase employment opportunities in this area.

There is increasing pressure on society to carve out sustainable paths of development and this will lead to public and private sector-led research and development institutions to develop technology solutions. This will also encourage business sectors – corporations as well as Small and Medium Enterprises (SMEs) – to adopt new green technologies, either voluntarily or in compliance with a growing number of environmental regulations. Today, environmentally concerned institutions are increasing efforts to facilitate the transfer of green technologies from the source (e.g. developed countries) to the South Asian nations.

Biotechnology offers powerful new tools for improving agricultural productivity, environmental sustainability, and nutritional quality of staple foods. These new technologies are helping to guide more precise crop and livestock breeding efforts, to diagnose crop and livestock diseases, and to develop more effective livestock vaccines. New crop varieties developed using biotechnology is being rapidly adopted by millions of large and small farmers in both industrial and developing countries. It is imperative for governments in South Asia to strengthen institutional governance

of biotechnology. This can be done by enhancing and streamlining government systems within a transparent, efficient and responsive regulatory framework.

To be responsive to both local needs and add value to existing regulatory, communications and policy capacities within the region, collaborations with ministries of agriculture, health, science and environment; district governments; national research and policy institutions; non-governmental organizations; farmers groups; and other development agencies are required.

Barriers to successful technology transfer

The parameters that act as barriers to successful technology transfer are:

- ❖ 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 since 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

Strategies to facilitate technology transfer within the region

Establishment of information dissemination centres or networks

Establishment of country-based information access points is important. These access points should be coordinated and networked with the other facilities for technology transfer, such as centres for training and demonstration. Information sources should be located close to end-users as this makes them aware of the existence of these sources and allows them easy access. Information should be clear and specific to provide focused answers to why green technology is needed, technologies available, their costs, benefits and drawbacks.

Technological cooperation is likely to be most successful when it takes place within a commercial environment, where both the provider and recipient have clear, self-interested motives.

Cooperation of member countries

Box 25: Mechanisms for Energy Security

Bangladesh

Low cost energy and long term availability, is a critical for development in Bangladesh. An optimal energy strategy for developing natural gas fields needs to be put in place. Capital could be provided by industry or an institutional lender for commercially viable discoveries. A ready market, viable pricing and a reliable payment mechanism to satisfy shareholders is required. The energy supply situation must fit well into the fundamental and ever-changing energy dynamics of South Asia, while delivering a long term sustainable benefits. Additionally, the use of renewal energy will add flexibility.

India

Regional energy collaboration reduces cost of energy and stimulates economic development while reducing air pollution and CO₂ emissions. In India, the prominent development goals relating to food security and energy security are biomass strategies. These are vital instruments for reconciling the competitive needs for land and water. Biomass strategies also deliver co-benefits such as land restoration, local employment and income from timber, fruits and fodder as well as enhancing mitigation and adaptation capacity to deal with climate change.

Source: Pugwash Conferences on Science and World Affairs 2002

Cooperation 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 organizations.

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 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 takes time and often companies (particularly SMEs) do not have the financial flexibility to wait for returns. Additionally, the loans needed by many companies are too small to interest the major lenders. 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 laboratory 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.

References:

Green Technology (2006). <http://www.green-technology.org/what.htm>

Pugwash Conferences on Science and World Affairs (2002). Challenges for Peace in the New Millennium. *51st Pugwash Conference on Science and World Affairs* 12-16 March 2002, Agra, India

MNP (2006). *How To Realize Benefits At National And International Level?* Policy brief: Integrated Development and Climate Policies. Netherlands Environmental Assessment Agency

UNEP (2001). South Asia: State of the Environment 2001. United Nations Environment Programme.



The understanding of entrepreneurial skills at the grassroots level will enable sustainable ecological practices

Photograph: Development Alternatives

Trade and Investments

It is important to enhance trade and investment by creating favourable microeconomic environments in the South Asian region. Enabling investments across the region will help integrate the regional economy into the global economy. Beyond economic benefits, increased investment can help improve environmental and social conditions by leading to more socially responsible corporate policies. The South Asian Watch on Trade, Economic and Environment (SAWTEE) is a partnership for capacity building to address liberalisation and globalization. Similarly business associations in the region also maintain their network links through the SAARC Chamber of Commerce and Industry and other alliances.

Intra-regional trade in South Asia is relatively low compared to other regions in Asia (Table 27). Intra-regional trade, as a ratio of South Asia's total foreign trade, was only 5.3 per cent in 2004, compared with 22.4 per cent for Association of Southeast Asian Nations (ASEAN) member countries. For individual countries, the intra-regional trade ratio varies from a low of 3.0 per cent for India and 5.0 per cent for Pakistan to a high of 47.2 per cent for Nepal and 35.3 per cent for Afghanistan.

Table 27: Intraregional Trade Share of South Asia's Total Trade 1985–2004 (%)

Country/Region	1985	1990	1995	2000	2004
Afghanistan	11.4	14.5	11.1	29.7	35.3
Bangladesh	4.7	6.0	12.8	7.9	10.5
Bhutan	-	-	-	-	-
India	1.7	1.6	2.7	2.5	3.0
Maldives	12.5	12.7	14.3	22.2	19.8
Nepal	34.3	11.9	14.8	22.3	47.2
Pakistan	3.1	2.7	2.3	3.6	5.0
Sri Lanka	5.5	5.6	7.8	7.4	15.1
South Asia	3.0	2.7	4.2	4.0	5.3

- Data not available

Source : Asian Development Bank Statistical Database System u.d.

India's trade within South Asia accounts for only 4 per cent of its total global trade and Pakistan's trade in the region accounts for 3 per cent of its overall trade. Compared to other countries with similar proximities and income levels,

intra-regional trade among SAARC states is relatively small. Much of the trade that is conducted in South Asia is also considered symbolic and generally does not involve goods vital to the economies of the countries. Moreover; some countries still have high tariff and non-tariff barriers to trade, indicating that the spirit of free trade does not seem alive in South Asia.

Starting from a relatively low base, enormous opportunities are available to expand intra-regional trade in South Asia. For example, a free trade agreement between India and Sri Lanka in 2001, increased Sri Lanka's exports to India from US\$71 million in 2001 to US\$168 million in 2002 and India's exports to Sri Lanka increased from US\$604 million in 2001 to US\$831 million in 2002. This trade agreement also stimulated new FDI, particularly from India to Sri Lanka for a wide range of products, such as rubber-based products and information technology. Similarly, following a bilateral trade protocol between India and Nepal in 1996, access to the Indian market was improved and trade expanded dramatically. Between 1996 and 2000, Nepal's exports to India increased tenfold from an annual average of about US\$30 million to over US\$300 million. Exports from India to Nepal quadrupled rising from US\$100 million to US\$400 million. At the same time, Indian investments in Nepal increased for a wide range of products, particularly light consumer goods such as toothpaste and ready-made garments where Indian entrepreneurs recognized the profitability of locating plants in Nepal for duty-free export to North Indian markets.

Similar possibilities exist for other South Asian countries. In 2002, the official bilateral trade between India and Pakistan was about US\$212 million, less than 1 per cent of their global trade. Regional cooperation can help open up new markets between India and Pakistan, and substantially increase trade between the two countries. A thriving border trade in a wide range of agricultural and industrial products exists between Bangladesh and India. However, a significant percentage of this trade also occurs on an informal basis. Therefore, trade liberalization in terms of reduced tariff and nontariff barriers can lead to formalization of informal trade, thereby reducing associated costs of informal trade such as rent-seeking activities and increasing revenue collection for the governments.

Constraints to intra-regional trade

Identical comparative advantage

The South Asian countries have an almost identical pattern of comparative advantage in a relatively narrow range of products. Revealed Comparative Advantage Ratios, a concept developed by Balassa in 1965, is a ratio of the share of a given product in a country's exports to its share in world exports. A country is said to have a revealed comparative advantage (disadvantage) in product if the ratio exceeds or falls short of unity. However, it may give misleading results amid distortions in the market. Similarly, their bilateral trade structures hardly show any complementarities in the trade structure. Together with absence of comparative advantage in capital intensive and high value-added products, which are normally imported by countries in the region, they act as structural constraints on expanding intra-regional trade.

Though South Asian countries have undergone major structural reforms and the share of industrial sector has increased sharply, their industry is not diversified. With the exception of India and, to some extent Pakistan, resource constraints have prevented the South Asian countries from investing in high value-added exportable product manufacturing industries and they are



The private sector supply chain and intensive marketing of products can be used to build a critical mass of awareness and demand

Photograph: Vasant Dave

dependent on industrialized countries for their capital goods and technology. The regional exports largely consist of raw materials and traditional products, such as textiles and garments, and some regional countries are competitors in the world export market for these products. The import requirements of the region mainly consist of capital goods and high-tech products. In this way, the trade pattern of the South Asian countries is tilted towards the developed countries. Similarly, limited trade in engineering goods is due to a number of factors including reliance on foreign aid to finance the import of capital goods, poor quality of goods and heavy import duties

Infrastructure and mechanisms

There is inadequate infrastructure for trade in South Asian countries and the production, consumption and trade patterns of potential trading partners within the region may not be sufficiently known. Similarly, inadequate trade facilitation mechanisms contribute to the unrealized potential of intra-regional trade in certain areas. For example, Nepal's trade with other countries in the region depends on transit facilities provided by India. These facilities often involve high handling and transportation charges and delays in delivery, thus hampering the flow of trade between Nepal and its trading partners in the region.

Restrictive trade policies

Restrictive trade policies also cause the low level of intra-regional trade. However, the South Asian countries have substantially liberalized their economies in the past decade. Some trade liberalization has also occurred under the SAARC Preferential Trading Agreement (SAPTA) regime and almost 5 000 products from all SAARC member countries are entitled to preferential duty treatment. There is, however, a general perception that the trade liberalisation episodes including SAPTA have not made any significant impact on intra-regional trade in South Asia.

Political compulsions

Political differences have also undermined efforts to foster regional economic cooperation in South Asia. India and Pakistan, the two largest economies of the region, have not been able to realise the full potential of their bilateral trade owing to various political compulsions. Small South Asian countries have been skeptical of regional economic cooperation initiatives as they fear domination by larger trading partners, which could be economically detrimental to their domestic industries. The prospects of trade cooperation have enhanced with improved relationships and signing of South Asia Free Trade Agreement.

Framework agreement of the South Asian Free Trade Area

Until recently, trade issues have primarily been dealt with on a bilateral rather than regional basis. In this regard, the Framework Agreement of the South Asian Free Trade Area (SAFTA) signed by SAARC leaders at the Islamabad Summit, 2004, was a significant step toward promoting free trade and investment in the region. One of the major objectives of SAFTA is to gradually remove tariffs in South Asia on specific items by 2015, which would help increase competitiveness; reduce transaction costs; and increase economic efficiency, trade and investment. The benefits of trade liberalization can be significantly increased if it is accompanied by trade facilitating measures, such as customs reform in simplifying and harmonizing rules, standards, procedures, classification, and documentation; transit agreements; banking facilitation and insurance; taxation reform; and improved transport infrastructure and border facilities. At the recently held Dhaka Summit, SAARC leaders directed the finalization of negotiations and completion of required national procedures to operationalize SAFTA by 1 January, 2006. By the end of 2005, all outstanding issues, including agreement of each country's sensitive list, the rules of origin and a customs revenue compensation mechanism had been resolved. As of early January 2006, all SAARC countries have ratified SAFTA except for Pakistan, where ratification is expected shortly. The coming into force of SAFTA in January 2006 will mark an important milestone for SAARC and a key step towards its long-term vision of a South Asian Economic Union. Similarly, efforts have also been undertaken under Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) to establish a free trade area among its member countries.

Market-based instruments

Market-based instruments (MBIs) should be an integral part of any strategy to strengthen environmental management at the regional level. In contrast to the traditional regulatory approaches, MBIs work through economic incentives to induce environmentally friendly behaviour. By allowing flexibility in attaining environmental goals (such as reduction in emissions), MBIs offer potential cost savings. Thus, a given environmental target can be attained at a lesser cost to society than through other regulatory approaches.

Instruments for environmental protection

Historically, public authorities have relied mainly on non-economic instruments for environmental protection. These include direct public provision of environmental benefits (for example, national parks), "command-and-control" regulation of technology, or uniform product and/or emissions standards. While such approaches can be effective, conventional environmental policies have been widely criticised on the grounds of their relative inefficiency, and the absence of explicit incentives for innovation.

MBIs attempt to harness market incentives in support of environmental objectives, by making environmental protection a more profitable or lower-cost option for producers and/or consumers. Two main advantages are claimed for such approaches: firstly, MBIs are more cost-effective than conventional policies, and secondly, if they are well-designed, MBIs can stimulate innovation and diffusion of environmentally-preferred technologies. In general, there are four types of market-based instrument can be distinguished

Pollution fees

These include a range of taxes and user fees designed to influence the behaviour of producers or consumers, such as taxes on industrial emissions, differential taxation of lead-free or diesel fuel, pay-as-you-throw charges for domestic or commercial waste, etc. The aim of such charges is to discourage environmentally damaging activities and/or strengthen incentives to reduce waste and pollution, while at the same time generating revenue which may be earmarked in certain instances for public environmental protection.

Tradable permits

Another option for governments, rather than setting the "price" of pollution through charges, is to fix the level of pollution considered acceptable and then allocate limited "rights to pollute" among polluting firms, along with the right to trade pollution quotas. This approach can lead to very cost-effective pollution control, as firms which can reduce pollution at relatively low cost have an incentive to reduce their emissions and sell surplus permits to other firms, with relatively high-cost pollution control, which in turn find it cheaper to buy permits than to reduce pollution. In some cases, governments may also raise revenue by auctioning pollution permits, or attach conditions to permit trading which result in gradual reduction in pollution quotas (and thus emissions) over time.

Market barrier reductions

A third category of market-based instrument involves the removal of legal, regulatory or other barriers to trade in natural resources and the internalization of environmental costs. This may include, for instance, better labelling and reporting schemes which provide consumers with information on the environmental performance of the products they buy or of the companies that make them. Another example is legal recognition of environmental liability and of mechanisms to assess damage claims, which can lead firms to take more account of the potential impact of their operations, or stimulate insurers to charge higher premiums for environmentally-risky activities.

Government subsidy reform

Finally, significant environmental improvement can often be obtained simply by removing or reforming existing government subsidies on environmentally damaging activities. Reduction of energy, water or fertilizer subsidies, for example, can lead to more efficient use of resource inputs and reduced pollution (although at some cost to resource users). Subsidy reform can also be a means of encouraging producers to adopt environmentally-desirable

practices such as incentives for organic cultivation, reserving areas for wildlife habitat or soil and water conservation, on farms. In some cases, subsidies may be justified to encourage activities characterized by significant non-market environmental benefits like recycling waste or sustainable forestry.

Whatever form they take, virtually all MBIs attempt to “internalize” non-market environmental values in private economic decision-making. They can have a dramatic effect on commercial activities, investment flows, and patterns of production and consumption. As a result, they can also have major impacts on people’s livelihoods, as well as the state of the environment.

References

ADB (u.d.) Asian Development Bank. <http://aric.adb.org/ti.php?section=3&subsection=research>

Dash, K. (1996). The Political Economy of Regional Cooperation in South Asia. *Pacific Affairs* (69) no 2. pp. 204

IUCN (1998). *Market Based Instruments for Global Environment Benefit & Local Sustainable Development. Lessons From Recent Developing Country Experiences*. The World Conservation Union.

Panagariya, A. (u.d.) *South Asia: Does Preferential Trade Liberalization make sense?* <http://www.columbia.edu/~ap2231/Policy%20Papers/Saarc-wb.pdf>

Panayotou, T. (1994). *Economic Instruments for Environmental Management and Sustainable Development*. Environmental Economics Series, Paper No. 16. United Nations Environment Programme, Nairobi.

Stavins, R. N. (1998). Market-Based Environmental Policies. In *Public Policies for Environmental Protection*. Portney, P.R. and Stavins, R.N. (eds.). Resources for the Future.

Thapar, R. (2006). SAARC Ineffective in Promoting Economic Cooperation in South Asia, *Stanford Journal of International Relations*.

The Economist (2002). The Unmagnificent Seven. *The Economist*, January, 2002



Increased investment will lead to economic benefits that can help improve environmental and social conditions

Photograph: Karen Winton



Ecosystem Services

Ecosystem services are the systems and processes through which natural ecosystems and species sustain human life. These include oxygen production, carbon sequestration, provision of clean water, assimilation of wastes, and flood regulation. The rising demand for ecosystem services, coupled with their reduced supply, will lead to growing vulnerability and conflicts over who gets the benefits and who pays the costs of disrupted ecosystems, in an already highly inequitable world. Eighty per cent of the world's gross domestic product belongs to the one billion people living in the developed world; five billion people in developing countries share the remaining 20 per cent (UN 2005). The region will also confront the large problems from ecosystem degradation. Overlaid will be the effects of growing pressures such as the buildup of nitrogen in rivers and coastal waters, species extinction, and increased incidence of droughts and floods from climate change.

Ecosystem Service Valuation (ESV) is being developed as a vehicle to integrate ecological understanding and economic considerations. It is a holistic approach for inventorying and quantifying the monetary value of these services so that various stakeholders including land owners, planners and policy makers can better understand the trade-offs when altering natural ecosystems.

The key to understanding the importance of ecosystems and incorporating this in economic and other policy decision-making is to establish the link between a given ecosystem and its goods and services and its valuation by individuals. Figure 49 demonstrates this link.



The distribution of benefits of ecosystem goods and services among different beneficiary groups at different time periods is a crucial factor when considering the value of ecosystem goods and services. Beneficiaries are individuals (the basic unit in estimating the total economic value), commercial entities and the public sector. Table 28 identifies these beneficiaries across the local, national, regional and global scales. Decisions are often biased in favour of the global community, especially the case when it comes to non-use and option values.

Another scale at which the conflicts between users, or trade-offs between uses, become evident is that of temporal variation of ecosystem goods and services. Benefits and beneficiaries vary in the short and long term, and these variations are clearer when exploitation of ecosystem goods in the short term, leads to a decline in ecosystem services over time. An example of this is logging which may lead to decline or loss of watershed and other services of forests.

Table 28: Beneficiaries Across The Local, Regional/National And Global Scales.

	Local	National/Regional	Global
Individual	Local users (e.g. hunter/ gatherer, subsistence farmers and fishermen, recreation)	(e.g. tourists, consumers, education)	(e.g. tourists, consumers, education)
Commercial entity	Local industry (e.g. entrepreneurs, farmers, traders, artisans)	Economic sectors, national and regional GDP	International enterprise (e.g.. fishery and forestry/industry)
Public sector	Local Government (e.g. tax revenue)	National Government (e.g. tax revenue, foreign revenue from sale of concessions)	International Community

Source: DEFRA 2005

A variety of policy choices are available to reduce the degradation of ecosystem services and retain the benefits for people. These include regulatory approaches (such as establishing 'no take' zones in fisheries), technological approaches (such as promoting drip irrigation systems to reduce water use) and economic approaches (which can include assigning private property rights to the resource) and enabling the owners to charge for the use of the service.

The nature of the service determines, in part, which approaches can be used. For example, it would be difficult to establish a market mechanism to capture the value of some ecosystem services, such as the benefits that ecosystems provide in regulating regional temperature and rainfall.

Furthermore, different societies can decide for themselves on the approach that would be most effective and culturally appropriate. It is up to societies to determine whether an ecosystem service should remain free to the consumer or whether markets should determine the value and thereby provide an incentive for maintaining the service or restrict access to the service by regulation. For example, although in many societies water is consumed as a free service, in others consumers pay for the delivery of water – or at least the cost of purification and delivery – in order to conserve and limit the waste of this valuable and scarce resource.

Economic instruments

In recent years, there has been an increase in the use of economic instruments to promote the conservation of ecosystem services. In some cases, the producers of services that were formerly provided freely have been paid by the government to provide those services. For example, Costa Rica has established a system of payments for ecosystem services under which farmers are paid to plant or maintain forest cover on their land, in order to maintain services that include water purification, erosion control, carbon sequestration, and biodiversity conservation.

In other cases, markets are being established for ecosystem services that were formerly freely available such as carbon markets that enable a landowner to be paid for management activities that increase sequestration of carbon. Many policy alternatives to market-based approaches exist, and different societies, and even members within societies, are likely to opt for different mechanisms as value systems differ over time and with changing circumstances. This makes the process of valuation difficult, except for those widely traded in the marketplace. Maintaining functioning ecosystems that provide essential services for human wellbeing, is the basis of sustainable development.

Current status of markets for ecosystem services

Determining precise and credible value of ecosystem services strengthens markets. This provides a transparent mechanism, not only for acceptable payment mechanisms but sustainable management of ecosystems as well. In the last decade, payment for different types of ecosystem services has emerged as one of the most innovative responses

for management of ecosystems.

In many cases, fiscal instruments such as subsidies are used to compensate for environmental services generated. There are many cases where the regulating services of wetland or forest ecosystem have been quantified and monetized. This has either enabled markets to function more efficiently.

Regular monitoring and assessment

With the combined efforts of local communities, civil society, research communities, governments and international organizations, regular collection and analysis of data on ecosystem services is fundamental to making informed decisions on issues that affect or are affected by ecosystem health. This data need to become easily available so that it can be commonly converted into economic data. The Millennium Ecosystem Assessment provides a framework for tracking the status and trends of ecosystem services.

The assessment found little information on the economic consequences of changes in ecosystem services or on the links between ecosystem services and human wellbeing, except for food and water. The challenge is to establish regular monitoring and assessment of services at all scales and to fill in the gaps identified in the assessment.

Future ecosystem monitoring and assessment needs to draw on both traditional and scientific knowledge, and emphasize the links between ecosystems and people. New technologies, such as web-based interfaces that display spatially referenced information on a virtual globe provide ways to share, analyse, and disseminate information across different levels. Once, more experience has been gained in monitoring and assessing ecosystem services, standards will be needed for factors such as data quality, measurement units and labelling. Such standards can help ensure that the resulting data can be aggregated and compared and that the results are appropriately used.

Identify and manage trade-offs

Local and national development planners, project developers, natural resource managers, and other public and private decision makers regularly make choices that trade one ecosystem service for another and determine who bears the costs and who benefits. However, tools to identify and provide information on these trade-offs are often unavailable or unused (WRI 2007). Examples of tools that offer promise include the Action Impact Matrix, several types of mapping, and scenarios.

The Action Impact Matrix is a fully participative, multistakeholder method which can be used at any scale or level to understand the two-way interactions between development policies and ecosystems (WRI 2007). Environmental impact assessments are often narrowly focused on the effects of development on ecosystems and not vice versa. The Action Impact Matrix could be used to integrate ecosystem management comprehensively into national sustainable development planning (WRI 2007). Table 29 illustrates the Matrix's use in national development planning in Sri Lanka.

Geospatial mapping offers another approach to identify and consider trade-offs in the distribution of the costs and benefits derived from ecosystem service use. Overlaying high-resolution maps of poverty and ecosystem services, for example, can highlight relationships that are important for policy development and poverty reduction.

Strengthen the rights of local people to use and manage ecosystem services

Ecosystem services are a lifeline for the poor in rural communities, who often do not have clear rights to the land, fisheries, forests or other resources they use and are unlikely to have the ability to influence decisions on managing resources.

In most countries, decisions on management and use of ecosystem services are made by national governments, international donors and multinational companies. Conservation groups have also played a prominent role through their efforts to protect nature by establishing parks and protected areas. However, it is increasingly recognized that more bottom-up approaches are required to involve local communities in decision making processes. Similarly, groups

Table 29: Using the Action Impact Matrix in Sri Lanka

Step 1:	Identify national development goals (e.g. economic growth, poverty reduction, employment, budget deficit reduction)
Step 2:	Identify critical ecosystems relevant to national development goals (e.g. forests, managed ecosystems (grain and tree crops), coastal, marine, wetlands, water resources)
Step 3:	Identify how development goals affect ecosystems. Use a two by two matrix with development goals on one side and critical ecosystems on the other, assign values (+ or - and 1-3 for impacts significance where 1 - low and 3 - high). (e.g., economic growth has a moderate negative effect on coastal ecosystem services by increasing coastal development; employment has a low positive effect on wetlands by creating job opportunities in sectors that do not depend directly on ecosystem services)
Step 4:	Identify how ecosystems affect development goals. Use the same two by two matrix from Step 3, Identify the relationship between critical ecosystems and development goals. (e.g., degraded water resources have a high negative effect on managed ecosystems; deforestation has a moderate negative effect on poverty reduction through impacting the poor dependent on forests for their livelihoods)
Step 5:	Prioritize development-ecosystem linkages and identify remedial strategies. (e.g., water resources and managed ecosystems - use of integrated river basin management; supply side water management options such as enhancing wetlands and use of ground cover to reduce evapotranspiration; and water pricing in irrigated agriculture)
Step 6:	Conduct detailed analysis of key interactions identified in Step 5. (e.g., multiscale analysis of water resource services - supply and demand)
Step 7:	Update and refine Steps 3-6 based on results of Step 6.

Source: Munasinghe 2007

working to reduce poverty and promote biodiversity conservation have a common cause in development policies and projects that emphasize the central role of the local community.

Devolution must be accompanied by appropriate safeguards to ensure the interests of a range of users. This might include national government setting minimum standards for resource use and access in the decentralization process.

Priority Programmes of Ministry of Environment and Natural Resources, Govt. of Sri Lanka

“Piyakaru Purawara” Green Cities Programme

The Green Cities – “Piyakaru Purawara” Programme is a Cabinet approved environment programme jointly implemented by the Ministry of Environment CEA and Local Authorities, Govt. of Sri Lanka. The programme is mainly concentrated on keeping the cities clean and beauty. The programme is enriched with number of vital components namely awareness creation, solid waste management, urban greenery, tree cover improvement and canal rehabilitation. Fifty three (53) Local Authorities (Las) have jointed this programme so far and contributed a lot for the development of collective efforts, strengthen the inter agency coordination and corporation at the grass root level to achieve the common objective “keep the cities clean and beauty”. Identification of problems which are connected to the city cleaning have been completed by all 53 Local Authorities. Out of 53 Las 23 have completed the first and second steps of this programme.

“Rana Derana” Programme

This programme has been initiated to identify alternatives for river sands, meet the sand requirements with the available sands as well as to give maximum value addition locally to the minerals that are being exported. In order to meet these objectives Mineral Investigation Unit has been established at GSMB and four types of minerals; Vein quartz, dimension stones, mica, iron ore have been identified in this regard. A study has also been carried out to assess how the value addition has been brought in and a draft Mineral Investment Agreement has been finalized. Stakeholder consultations in this regard are being conducted to implement this programme.

“Haritha Gammana” Eco Village Programme

This programme has been initiated with the main objectives to,

- ❖ Ensure environmental sustainability of village development programme carried out by various agencies
- ❖ Minimize environmental degradation
- ❖ Conserve village biodiversity
- ❖ Enhance socio economic status of village communities
- ❖ Make a pleasant village environment

“Jeewa Jawaya” Programme

Bio diesel can be taken as a substitute for, or an additive to diesel fuel, which is derived from oils and fats of plants like *Jatropha crucas*. As a substitute for fast depleting fossil fuels, bio diesel has come to stage. In future it should also serve to reduce and maintain the price of automobile fuel. Under exploited and unexploited vegetable oils are good source of bio fuel. Our country is endowed with many such plants and *Jatropha crucas* is considered as one of the best option.

“Gaja Mithuro” Elephant Conservation Programme

The main objective of this programme is to transform Human elephant Conflict into Human Elephant Coexistence through achieving followings.

- ❖ Reduce human deaths due to elephant attack
- ❖ Reduce property and crop damages
- ❖ Reduce elephant deaths
- ❖ Reduce injuries to elephants including gunshot injuries
- ❖ Making elephants as friends of community

“Dewa Jawaya” Programme

“Dewa Jawaya” is one among the 10 priority projects initiated by the State Timber Corporation. The project spanning from 2008 to 2012 consists of following long term objectives.

- ❖ To increase the production and competitiveness of furniture and other wood based projects
- ❖ To maximize utilization of under utilized timber species
- ❖ To increase the market share of sawn timber while meeting customer expectation
- ❖ To expand timber sale outlet chain with a view to capture major share in the timber market by the STC

“Helathuru Viyana” Programme

The forest Department, after a careful study, has now stopped planting Pinus in Sri Lanka. Also these Pinus plantations are located in areas with a higher slope. Therefore, through this “Helathuru Viyana” programme, it is expected to convert Pinus plantations into native broadleaved species with an appropriate scientific methodology. The main objective of “Helathuru Viyana” is resting degraded forest ecosystems with native plant species.

References

DEFRA (2005). *The Economic, Social and Ecological Value of Ecosystem Services: A Literature Review*. Department for Environment, Food and Rural Affairs.

Kumar, P. (2005). *Market for Ecosystem Services*. International Institute for Sustainable Development.

Ministry of Environment and Natural Resources, Govt. of Sri Lanka

UN (2005). *The Inequality Predicament*. Report on the World Social Situation 2005. United Nations

WRI (2007). *Restoring Nature's Capital: An Action Agenda to Sustain Ecosystem Services*. World Resources Institute.

WRI (2007). *Policies for Sustainable Governance of Global Ecosystem Services*. World Resources Institute.

Acronyms

ABC	Atmospheric Brown Cloud	CNP	Chitwan National Park
AirMAC	Air Resource Management Centre	CPCB	Central Pollution Control Board
AIMS	Australian Institute of Marine Science	CSO	Civil Society Organization
APCSS	Asia-Pacific Center for Security Studies	DA	Development Alternatives
ASEAN	Association of South East Asian Nations	DEFRA	Department for Environment, Food and Rural Affairs
ADB	Asian Development Bank	ESMAP	World Bank Energy Sector Management Assistance Programme.
BCAO	Biodiversity Conservation Action Plan	EIA	Environmental Impact Assessment
BCAS	Bangladesh Centre for Advanced Studies	EPA	Environmental Protection Agency (of the United States)
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation	ESA	Endangered Species Act
Bkwh	Billion kilowatt hours	ESV	Ecosystem Service Valuation
BZ	Buffer Zone	ETS	Emissions Trading Scheme (European Union)
BZDC	Buffer Zone Development Council	FAO	Food and Agriculture Organization of the United Nations
CANA	Climate Action Network Australia	FSC	Forest Stewardship Council
CANSA	Climate Action Network South Asia	NGO	Non-governmental Organization
CBD	Convention on Biological Diversity	GEF	Global Environment Facility
CDF	Comprehensive Development Framework	GEO	Global Environment Outlook (of UNEP)
CDM	Clean Development Mechanism	GHG	Greenhouse gas
CEA	Central Environmental Authority	GIS	Geographic Information System
CFC	chlorofluorocarbon	GLASOD	Global Assessment of Soil Degradation
CH ₄	methane	GLOF	Glacial Lake Outburst Flood
CI	Conservation International	GRAIN	Genetic Resources Action International
CITES	Convention on International Trade in Endangered Species	HCFC	hydrochlorofluorocarbon
CO	carbon monoxide	Heritage	Convention Concerning the
CO ₂	carbon dioxide	Convention	Protection of the World Cultural and Natural Heritage
CNG	Compressed Natural Gas		

HKH	Hindu Kush-Himalayan	KNR	Kanchanjungha Nature Reserve
IAS	Invasive alien species	Kyoto Protocol	Kyoto Protocol to the UN Framework Convention on Climate Change
ICARM	Integrated Coastal Area and River Basin Management		
ICDS	Integrated Child Development Services program	LED	Light Emitting Diodes
ICIMOD	International Centre for Integrated Mountain Development	LNG	Liquefied Natural Gas
ICZM	Integrated Coastal Zone Management	MA	Millennium Ecosystem Assessment
IEA	International Energy Agency	MBI	Market-based Instruments
IFPRI	The International Food Policy Research Institute	MDGs	Millennium Development Goals
IGAD	Intergovernmental Authority on Development	MNP	Netherlands Environmental Assessment Agency
IISD	International Institute of Sustainable Development	MPA	Marine Protected Area
IMF	International Monetary Fund	MSC	Marine Stewardship Council
IMO	International Maritime Organization	Mtoe	million tones of oil equivalent
INDOEX	Indian Ocean Experiment	NAP	National Allocation Plans
IPCC	Intergovernmental Panel on Climate Change	NARA	National Aquatic Resources Development Agency
IRRI	International Rice Research Institute	NELP	New Exploration Licensing Policy
ISRIC	International Soil Reference and Information Centre	NGO	Non-governmental organization
ITOPF	The International Tanker Owners Pollution Federation Limited.	NO _x	oxides of nitrogen
IUCN	The World Conservation Union	O ₃	tropospheric ozone
IUU	Illegal, Unregulated and Unreported (fishing)	ODP	Ozone-depleting potential
IWMI	International Water Management Institute	OECD	Organization for Economic Co-operation and Development
IWRM	Integrated Water Resources Management	PM	particulate matter smaller than x micrometres
IYDD	International Year of Deserts and Desertification	ppm	parts per million
KCA	Kanchanjungha Conservation Area	PPP	purchasing power parity
KgoE	kilogram of oil equivalent	PRB	Population Reference Bureau
		PSA	Production Sharing Agreements
		Ramsar Convention	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
		SAARC	South Asian Association for Regional Cooperation
		SACEP	South Asia Cooperative Environment Programme

SACOSAN-2	Second South Asian Conference on Sanitation	UNEP	United Nations Environment Programme
SAFTA	South Asian Free Trade Area	UNEP RRC.AP	United Nations Environment Programme Regional Resource Centre for Asia-Pacific
SANDEE	South Asian Network for Development and Environmental Economics	UNESCO	United Nations Educational, Scientific and Cultural Organization
SAPTA	SAARC Preferential Trading Agreement	UNFCC	United Nations Framework Convention on Climate Change
SAS	South Asian Seas	UNICEF	United Nations Childrens Fund
SAWTEE	South Asian Watch on Trade, Economic and Environment	USAID	United States Agency for International Development
SME	Small and Medium Enterprises	USCSP	US Country Studies Program
SO ₂	sulphur dioxide	VOC	volatile organic compound
SSR	self sufficiency ratio	WHO	World Health Organization
Stockholm Convention	Convention on Persistent Organic Pollutants	WMO	World Meteorological Organization
TAR	Tibetan Autonomous Region	WPI	Water Poverty Index
TBPA	Transboundary Protected Area	World Bank	The World Bank, International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA)
Tcf	trillion cubic feet		
TERI	The Energy and Resources Institute		
UNCCD	United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification Particularly in Africa	WRI	World Resources Institute
		WSSD	World Summit on Sustainable Development
UNDAF	United Nations Development Assistance Framework	WTO	World Trade Organization
		WUA	Water User Associations
UNDP	United Nations Development Programme	WWF	World Wide Fund for Nature
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific.		

List of Boxes

Box 1:	Good Practices in Partnerships: Air Resource Management Centre (AirMAC) in Sri Lanka	19
Box 2:	Compressed Natural Gas (CNG) as Fuel for Transport in Pakistan	20
Box 3:	Atmospheric Brown Cloud	21
Box 4:	Safe and Improved Drinking Water Sources	25
Box 5:	Affecting Millions in Bangladesh: Arsenic in Groundwater	27
Box 6:	Status of Marine Protected Areas in South Asia	33
Box 7:	Ensuring Sustainable Ornamental Fishing in Sri Lanka	37
Box 8:	The Chitwan National Park, Nepal: A Category V Buffer Zone	40
Box 9:	A Trans-boundary Protected Area in the Kanchanjunga Region of the Eastern Himalayas	41
Box 10:	Melting Glaciers and Threat of Glacial Lake Outburst Floods	46
Box 11:	Preventing Catastrophies: An Early Warning System in the Lunana region, Bhutan	47
Box 12:	Rising Sea Levels: Impact on livelihoods	48
Box 13:	Launch of National Disaster Information System	52
Box 14:	Consequences in the Future	53
Box 15:	National Action Plan on Climate Change	55
Box 16:	Oil Spills in the Indian Ocean	72
Box 17:	Negative Consequences of Groundwater Overdraft	74
Box 18:	Area Water Partnerships	76
Box 19:	United Solutions: South Asia Capacity Building Initiatives on Water	77
Box 20:	Successful Initiatives: Water Panchayat in Rajasthan, India	78
Box 21:	Replicating a Practice from Denmark: Cooperatives	85
Box 22:	An Alliance to Advance Renewable Energy Usage	87
Box 23:	Human Development	90
Box 24:	Recycling Waste in Namakkal, India	93
Box 25:	Mechanisms for Energy Security	109

List of Figures

Figure 1: Net private capital flows to South Asia	6
Figure 2: Comparison of land use	9
Figure 3: Percentage of total land that is arable	10
Figure 4: Irrigated land as a percentage of total agricultural area	11
Figure 5: Total fertilizer consumption for south asia (million tonnes)	11
Figure 6: Total cereal production in South Asia	11
Figure 7: Density of cattle (number per hectare)	11
Figure 8: Density of goats (number per hectare)	11
Figure 9: Rural population (percentage of total population) and population density (people per hectare)	12
Figure 10: Plantation forest (percentage of total forest area)	13
Figure 11: Annual percentage change in forest area	13
Figure 12: Percentage of land affected by all types of wind erosion (loss of topsoil, terrain deformation & off-site affects)	14
Figure 13: Percentage of land affected by all types of water erosion (loss of topsoil, terrain deformation & off-site affects)	14
Figure 14: Percentage of desert and dryland by country in 2003	14
Figure 15: Consumption of diesel and gasoline by the road sector	17
Figure 16: 24-Hour average PM2.5 data at semi-residential area, Dhaka, Bangladesh	18
Figure 17: 24-Hour average PM2.5 data at Fort Railway Station, Colombo, Sri Lanka	19
Figure 18: 24-Hour average PM2.5 data in Delhi, Kolkata and Mumbai, India	19
Figure 19: Suspended particulate matter concentrations in South Asia	19
Figure 20: Total suspended particle matter concentration in major cities	20
Figure 21: Sulphur dioxide concentration in major cities	20
Figure 22: Nitrogen oxides concentration in major cities	20
Figure 23: Total carbon dioxide emissions	21
Figure 24: Carbon dioxide emissions per capita	21
Figure 25: Nitrogen oxides emissions	21
Figure 26: Sulphur dioxide emissions	21
Figure 27: Coverage with improved drinking water sources in 2002	25
Figure 28: Access to improved drinking water sources	26
Figure 29: Water Poverty Index	26
Figure 30: Change in protected area	35
Figure 31: Total forest area (Thousand hectares)	35
Figure 32: Threatened bird species	36
Figure 33: Threatened mammal species	36
Figure 34: Threatened plant species	36
Figure 35: Protected area cover in South Asia as a percentage of total land area, 2004	40

Figure 36: GDP growth (annual %)	62
Figure 37: Agriculture value added (% of GDP)	63
Figure 38: Agriculture labour force as a percent of total labour force	63
Figure 39: Changes in commodity composition of food (Kg/ capita/ year)	64
Figure 40: Growth rates (% per year)	64
Figure 41: Cereal balances	65
Figure 42: Fertilizer consumption (thousand metric tons)	65
Figure 43: Fertilizer use intensity (kilograms per hectare)	65
Figure 44: Water use intensity (m ³ /ha/yr)	65
Figure 45: Sectoral withdrawals (percent) 2000	71
Figure 46: Arable land (million ha)	71
Figure 47: Electricity consumption per capita (kilowatt-hours per person)	82
Figure 48: Per capita total expenditure of health	94
Figure 49: Link between ecosystems and goods and services	116

List of Tables

Table 1:	Growth Rate of Gross Domestic Product (per cent)	7
Table 2:	Major Farming Systems in South Asia	10
Table 3:	Water Logging and Salinization in Bangladesh, India and Pakistan	15
Table 4:	Glacier Resources in the Himalayas	25
Table 5:	Advancing or Retreating of Glaciers over Different Periods	25
Table 6:	Sanitation Coverage in South Asia	26
Table 7:	Summary of the Distribution, Nature, and Scale of Documented Arsenic Problems (>50 µg-1) in Aquifers in South and East Asia	27
Table 8:	The Three Main Rivers in South Asia	28
Table 9:	Major River Basins in South Asia	29
Table 10:	Categories of Hotspots	31
Table 11:	Ramsar Sites	31
Table 12:	Nature Conservation Sites in South Asia - UNESCO World Heritage Sites	32
Table 13:	Cases of Biopiracy	39
Table 14:	Summary of Key Observed Past and Present Climate Trends and Variability in South Asia	46
Table 15:	Rainfall Scenarios for 2010 and 2070 (% change)	50
Table 16:	Food Consumption	64
Table 17:	Water Requirement - Equivalent of Main Food Products	71
Table 18:	Major Tanker Spills of over 5000 Tonnes in the South Asian Seas Region Since 1974	73
Table 19:	Commercial Energy Consumption	82
Table 20:	Level of Electrification in South Asia	84
Table 21:	Urban Population as a Percent of Total Population	89
Table 22:	Human Development Index	89
Table 23:	Percent of urban population living in slums	90
Table 24:	Water and Sanitation: Urban Access to an Improved Water Source	91
Table 25:	Passenger cars per 1 000 people	91
Table 26:	Some innovative environmental education (EE) activities undertaken in South Asia	101
Table 27:	Intraregional Trade Share of South Asia's Total Trade 1985-2004 (%)	111
Table 28:	Beneficiaries Across The Local, Regional/National And Global Scale	117
Table 29:	Using the Action Impact Matrix in Sri Lanka	119

*Inception Workshop for Preparation of South Asia
Environment Outlook 2006*

23 – 24 August, 2006, Kathmandu Nepal



List of Participants

Md. Saifur Rahman

Assistant Chief
Ministry of Environment and Forests,
Govt. of the Peoples Republic of Bangladesh,
Bangladesh Secretariat, Dhaka
Tel: 88-02-7174996
Fax: 88-02-7169210
email: plan6@moe.gov.bd
saifur69@yahoo.com

MD Golam Rabbani

Senior Research Officer
Bangladesh Centre for Advanced Studies(BCAS)
House 10, Road 16A, Gulsan - 1
Dhaka- 1212, Bangladesh
Tel: 880-2-8851237(O),8270131(R)
Fax: 880-2-28851417
Fax: 880-2-28851417
e-mail: golam.rabbani@bcas.net

Ugen Tenzin

Chief Program Officer
National Environment Commission
P.O.Box 466, Thimphu, Bhutan
Tel: (975-2)-325856, 323384 (O)/ 3286373(R)
Fax: (975-2)-323385
e-mail: utenzin@nec.gov.bt

Khum Raj Punjali

Joint-Secretary and Chief
Environment Division
Ministry of Environment, Science & Technology
Secretarial Complex, Singha Durbar
Kathmandu, Nepal
Tel: (977-1) 4225596(O), (977-1) 4483629(R)
Fax: (977-1) 4225474
e-mail: kpunjali@most.gov.np

Batu Krishna Uprety

Chief, Environment Assessment Section
Ministry of Environment Science & Technology
Secretarial Complex, Singha Durbar
P.O. Box 4008 Kathmandu, Nepal
Tel: (977-1) 4244609(O), 4479359(R)
Fax: (977-1) 4225474
e-mail: upretybk@wlink.com.np

Dr. Chhewang Namgel Lama

Agriculture Officer/ UNEP Focal Person,
Ministry of Environment Science & Technology
Singha Durbar Secretarial Complex,
P.O. Box 12343 Kathmandu, Nepal
Tel: (977-1) 4247391(O), 4495564(R)
e-mail: chhewang@yahoo.com

Yogendra Chitrakar

Director,
Environment Camps for Conservation Awareness
ECCA, Wise-use House, Jwagal, Lalitpur
P.O.Box 9210 Kathmandu, Nepal
Te: (977-1)-5553870 (O), 5523268 (R)
Fax: (977-1)-5011006
e-mail: ecca@mos.com.np

Bhawani Prasad Kharel

Senior Program Officer, IUCN
Bakhundole, Lalitpur, Nepal
Tel: (977-1)-5528781(O), 4472203(R)
e-mail: bhawani@iucn.org.np

Shahzad Iqbal

Deputy Secretary
Ministry of Environment
CDA Block No. IV, Civic Centre, G-6,
Islamabad, Pakistan
Tel:+92-51-9202725(O), +92-51-9230134(R)
e-mail: shahzadiqbal@yahoo.com

Mr Gul Najam Jamy

Head
Islamabad Program Office IUCN
38, street 86, Main Embassy Road Sector G6/3,
Islamabad, Pakistan,
Tel: (92-51)-2270686 (O), 4102633
email: gulnajam.jamy@isb.iucn.org

Dr. A.A. Boaz

Director General
South Asia Co-operative Environment Programme
(SACEP)
#10, Anderson Road, Colombo 05, Sri Lanka
Tel: 0094-11-2589376 (O), 2826300(R)
Fax: 0094-11-2589369
e-mail: draboaz@yahoo.com

Ms. A.L.S. Nazeema

Asst. Director,
Ministry of Environments
82, Sampathapaya, Bataramulla
Sri Lanka
Tel: 94-11-2887061(O)/ 94-714-333-637(R)
E-mail: nazeema@menr.lk
nazeema7@hotmail.com

Ms. Ermilinda Dias

Deputy Secretary,
Ministry of Environment and Forests,
Govt. Of India,
Paryavaran Bhanwan
CGO Complex, New Delhi -3
Tel: (91-11)-24366739(O), 24367623(R)
email: melindadias@yahoo.co.in

Dr. Syamal kumar Sarkar

Director,
Regulatory Studies and Governance Division.
TERI (The Energy and resource Institute)
Darbari Seth Block India,
Habitat Place, Lodhi Road
New Delhi – 110 003, India
Phone: 91-11-2468 2111 (O)/ 91-11-25075657
Fax: 91-11-24682144/24682145
e-mail: sksarkar@teri.res.in

Mr. Matthew Kahane

Resident Representative
UNDP, UN House, Katmandu, Nepal
TEL: 977-1-5523200
FAX: 977-1-5523991, 5523986
e-mail: REGISTRY.NP@UNDP.ORG;
sarita.tuladhar@undp.org

Mr Sonam Tshong

Director
Division of Environment Science and Technology
SAARC, SAARC Secretariat
P.O.Box 4222, Kathmandu, Nepal
Tel: 9228929 (O), 5543575(R)
Fax: 4220733
e-mail: dirbhu@saarc-sec.org

Dr. Madhab Karki,

Acting Director General
International Centre for Integrated Mountain
Development (ICIMOD)
Khumaltar, Lalitpur
P.O.Box. 3226 Kathmandu, Nepal
Tel: (977-1) 5525313 (O)
Fax: (977-1) 552509/ 5536747
e-mail: mkarki@icimod.org

Ms. Bidya Banmali Pradhan

Environment Officer
ICIMOD
Khumaltar, Lalitpur
P.O.Box. 3226 Kathmandu, Nepal
Tel: (977-1) 5525313 (O)
Fax: (977-1) 552509/ 5536747
e-mail: bbanmali@icimod.org.np

George C. Varughese

President
Development Alternatives
B32, TARA Crescent, Qutab Institutional Area,
New Dehli 16,
Tel: 91-11-26134103, 26890380
Fax: 91-11-26130817
Email: gcvarghese@deval.org

Dr. K. Vijaya Lakshmi

Vice President
Development Alternatives
B32, TARA Crescent, Qutab Institutional Area,
New Dehli 16,
Tel: 26130899(O), Mobile:9871439649
Email: konerlu.vl@gmail.com

Anand Kumar

Programme Manager
Development Alternatives
B32, TARA Crescent, Qutab Institutional Area,
New Dehli 16,
Tel: 91-11-2689- 0380(O), 9818262390
email: akumar3@deval.org
anandbhu@gmail.com

Udit Mathur

Programme Manager
Development Alternatives
B32, TARA Crescent, Qutab Institutional Area,
New Dehli 16,
Tel: 91-11-2689- 0380(O)
email: uamthur@deval.org

K. Anjana

Env. Management executive
Development Alternatives
B32, TARA Crescent, Qutab Institutional Area,
New Dehli 16,
Tel: 91-11-2689- 0380(O), 011-55424613(R)
Mobile: 9868394074
e-mail: anjana_doc@yahoo.com, kanjana@deval.org

Mr. Surendra Shrestha

Regional Director and Representative UNEP Regional
Office for Asia and Pacific United Nations Bldg.
Rajdamnern Ave. Bangkok 10200, Thailand Tel:
(662)2881870, 22816101, Fax: (662)2803829;
ISDN: +6623024119-20,23024069
email: surendra.shrestha@rrcap.unep.org

Mr. Jinhua Zhang

Regional Coordinator
UNEP Regional Resource Center for Asia and the
Pacific
c/o Asian Institute of Technology
3rd Floor, Outreach Building
P.O. Box 4, Klongluang,
Pathumthani 12120, Thailand
Tel:+66(02)516-0110-44,
Fax:+66(02)584 0305, 516-2125,524-6233
e-mail: jinhua.zhang@rrcap.unep.org

Dr.Subrato Sinha

Environmental Affairs Officer
United Nations Environment Programme
for Asia and the Pacific (UNEP ROAP)
2nd Floor, Block-A, United Nations Building
Rajdamnern Nok Avenue, Bangkok 10200
Tel: 66-2-2882259, Fax: 66-2-2803829
mobile:66-1-9066581
Email: sinha6@un.org

Mr Purna Chandra Lal Rajbandari

Senior Program Officer, Regional Resource Center- Asia
Pacific
United Nation Environment Program
Asian Institute of Technology
GPO Box 4, KlongLuang
Pathumthani 12120, Thailand
Phone: (66-2)524 6238 (direct) 5162124, 5160110
Fax: (66-2)524 6233 5162125
e-mail: purna.rajbandari@rrcap.unep.org

Aida N. Karazhanova (Ms., Dr.)

Program Officer, Capacity Building
UNEP Regional Resource Center for Asia and the
Pacific
c/o Asian Institute of Technology
3rd Floor, Outreach Building
P.O. Box 4, Klongluang,
Pathumthani 12120, Thailand
Tel:+66(02)524-5391,516-0110-44,ext 5391
Fax:+66(02)516-2125,524-6233
Cel: 04914-8387
e-mail: aida.karazhanova@rrcap.unep.org

*Consultation Workshop On South Asia
Environment Outlook 2007*

6-8th June 2007, Kathmandu Nepal



List of Participants

Mr. Ugen Tenzin

Programme Head
Policy and Coordination Division, NEC Secretariat,
Bhutan
Tel: 975-2-323384 (O)
975-17607928 (M)
Email: utenzin@nec.gov.bt

Mr. Mewang Gyeltshen

Head of Division
Renewable Energy Division
Department of Energy,
Ministry of Trade and Industry,
Thumphu Bhutan.
Phone No. 975 2 322709 (General Office), 334741
(Direct),
Mobile # +975 -17660179
Fax No 975 2 324676
Email: mewang09@yahoo.co.uk

MD. Golam Rabbani

Senior Research Officer
Bangladesh Centre for Advanced Studies(BCAS)
House 10, Road 16A, Gulsan - 1
Dhaka- 1212, Bangladesh
Tel: 880-2-8851237(O),
Fax: 880-2-28851417 880-2-28851417
Email: golam.rabbani@bcas.net

Dr. Mostafa Kamal Farooque

Project Director, NSDS Project
Department of Environment
Ministry of Environment and Forests
Government of Bangladesh
Poribesh Bhaban
E-16, Agargaon, Sher-e-Bangla Nagar
Dhaka-1207, BANGLADESH
Tel: +880-2-912-9864
Fax: +880-2-912-9864
Email: drfarooque@doe-bd.org

Md. Mustafizur Rahman Akhand

Senior chemist
Department of Environment
Poribesh Bhaban
E-16, Agargaon, Sher-e-Bangla Nagar
Dhaka-1207, BANGLADESH
Tel: +880-2-911-2490 Fax: +880-2-911-8682
e-mail: akhand@doe-bd.org

Dr. S K Sarkar, IAS

Director
Regulatory Studies and Governance Division. TERI
Habitat Place, Lodhi Road
New Delhi – 110 003
Phone: +91 11 2468 2100/ 41504900
Fax: +91 11 2468 2144/2145
Email: sksarkar@teri.res.in

Pratibha Raj

Deputy Secretary
Ministry of Environment and Forests
Paryavaran Bhawan, CGO Complex,
New Delhi-110003
Tel: (91 11) 2436 6739
Fax: (91 11) 2436 6734
Email: pratibha_rj@yahoo.co.in

Mr. Owais Nauman Kundi

Deputy Secretary
Ministry of Environment
Government of Pakistan
Tel: 92-51-9204491
Fax: 92-51-9202211
E-mail:owaisnauman@yahoo.com

Mr. Mathbar Adhikari

Under Secretary
Ministry of Environment Science & Technology
Secretarial Complex, Singha Durbar
P.O. Box 4008 Kathmandu, Nepal
Tel: (977-1) 4244609(O),
Fax: (977-1) 4225474

Dr Chhewang Namgel Lama

Agriculture Officer
Ministry of Environment Science & Technology
Secretarial Complex, Singha Durbar
P.O. Box 4008 Kathmandu, Nepal
Tel: (977-1) 4244609(O),
Fax: (977-1) 4225474

Mr. Yogendra Chitrakar

Director
Environment Camps for Conservation Awareness
ECCA, Wise-use House, Jwagal, Lalitpur
P.O.Box 9210 Kathmandu, Nepal
Te: (977-1)-5553870 (O), 5523268 (R)
Fax: (977-1)-5011006
e-mail: ecca@mos.com.np

Dr. Narpat Jodha

Senior Research Associate
ICIMOD
e-mail:njodha@icimod.org

Bidya Banmali Pradhan

Environment Officer
ICIMOD
e-mail: bbanmali@icimod.org

Ms. Rejina Maskey

ICIMOD
e-mail:rmaskey@icimod.org

Mr. Sonam Tshong

Director
Division of Environment Science and Technology
SAARC, SAARC Secretariat
P.O. Box 4222, Kathmandu, Nepal
Tel: 9228929 (O), 5543575 (R) Fax: 4220733
e-mail: dirbhu@saarc-sec.org

Ms. Diana de Alwis

Senior Programme Officer
IUCN-The World Conservation Union
Sri Lanka Country office
53, Horton Place, Colombo 7, Sri Lanka
Tel. ++94-011-2694094, 2682418
Fax: 2682470
Email: dda@iucnsl.org

Mrs. A.L.S. Nazeema

Asst. Director,
Ministry of Environments and Natural Resources
82, Sampathapaya, Bataramulla, Sri Lanka
Tel: 94-11-2887061(O)/ 94-714-333-637(R)
E-mail: nazeema@menr.lk
nazeema7@hotmail.com

Mohamed Zuhair

Deputy Director, Protected Area Management
Ministry of Environment, Energy and Water, Maldives
Tel: 3324861, Fax: 3322286
e-mail: Mohamed.zuhair@environment.gov.mv

Mr. Ganga Jang Thapa

Executive Officer
National Trust for Nature Conservation
P.O. Box 3712, Kathmandu
Jawalakhel, Lalitpur, Nepal
Tel: 977-1-5526571/73 Fax: 977-1-5526570
e-mail: gjthapa@ntnc.org.np
Web: www.ntnc.org.np

Mr. Binod Basnet

Program Officer
National Trust for Nature Conservation
P.O. Box 3712, Kathmandu
Jawalakhel, Lalitpur, Nepal
Tel: 977-1-5526571/73 Fax: 977-1-5526570
e-mail: binod@ntnc.org.np
Web: www.ntnc.org.np

Dr. Surendra Shrestha

Regional Director
UNEP Regional Office Asia and the Pacific
UNESCAP Building
Rajdamnonnok Avenue
Bangkok, THAILAND
Tel: +66-2-288
e-mail: surendra.shrestha@rrcap.unep.org

Mr. Jinhua Zhang

Regional Coordinator for Asia and the Pacific
UNEP Regional Resource Centre for Asia and the Pacific (UNEP RRC.AP)
UNEP Regional Resource Centre for Asia and the Pacific
c/o Asian Institute of Technology
P.O. Box-4, Klongluang,
Pathumthani-12120,
THAILAND
Tel: +66-2-5245390
Fax: +66-2-5162125/5246233
e-mail: Jinhua.Zhang@rrcap.unep.org

Dr. Subrato Sinha

Environmental Affairs Officer
UNEP Regional Office Asia and the Pacific
UNESCAP Building
Rajdamnonnok Avenue
Bangkok, THAILAND
Tel: +66-2-2882259
e-mail: sinha6@un.org

Mr. Purna Chandra Lall Rajbhandari

Senior Program Officer
UNEP Regional Resource Centre for Asia and the Pacific
c/o Asian Institute of Technology
P.O. Box 4, Klongluang
Pathumthani 12120,
THAILAND
Tel: +66-2-524 6238
Fax: +66-2-5162125 / 5246233
Email: Purna.Rajbhandari@rrcap.unep.org

George C. Varughese

President
Development Alternatives
B-32, TARA Crescent, Outab Institutional Area,
New Dehli - 110 016, India
Tel: 91-11-26134103, 26890380
Fax: 91-11-26130817
Email: gcvarghese@devalt.org

Dr. K. Vijaya Lakshmi

Vice President
Development Alternatives
B-32, TARA Crescent, Outab Institutional Area,
New Dehli - 110 016, India
Tel: 91-11-26134103, 26890380, 26130899(O),
Mobile: 9871439649
Fax: 91-11-26130817
Email: konerlu.vl@gmail.com

Anand Kumar

Programme Manager
Development Alternatives
B-32, TARA Crescent, Outab Institutional Area,
New Dehli - 110 016, India
Tel: 91-11-26134103, 26890380, 9818262390
Fax: 91-11-26130817
email: akumar3@devalt.org
anandbhu@gmail.com

K. Anjana

Env. Management Executive
Development Alternatives
B-32, TARA Crescent, Outab Institutional Area,
New Dehli - 110 016, India
Tel: 91-11-26134103, 26890380, Mobile: 9868394074
Fax: 91-11-26130817
e-mail: anjana_doc@yahoo.com, kanjana@devalt.org

Ridhima Sud

Environment Scientist
Development Alternatives
B-32, TARA Crescent, Outab Institutional Area,
New Dehli - 110 016, India
Tel: 91-11-26134103, 26890380, Mobile: 9868394074
Fax: 91-11-26130817
e-mail: ridhima.sud@gmail.com
rsud@devalt.org

United Nations Environment Programme

Regional Office for Asia and the Pacific (ROAP)
2nd Floor, United Nations Building Rajdamnern
Nok Avenue Bangkok 10200, Thailand
Telephone: 662 288 1870-4 Fax: 662 280 3829
Email: uneproap@un.org
Website: <http://www.roap.unep.org>

South Asian Association For Regional Cooperation Secretariat

SAARC Secretariat, Tridevi Marg, P.O. Box 4222, Kathamndu, Nepal.
Tel: +977 1 422 1785, +977 1 422 6350
Fax: +977 1 422 7033, +977 1 422 3991
E-Mail: saarc@saarc-sec.org
Website: www.saarc-sec.org

Development Alternatives

B-32, TARA Crescent, Qutub Institutional Area,
New Delhi 110 016, INDIA
Tel: (+91) - 11 - 2613 4103. Fax: (+91) - 11 - 2613 0817
E-mail: mail@devalt.org