SOUTH ASIA ENVIRONMENT OUTLOOK 2014

SAARC

UNEP

Development Alternatives

South Asia Environment Outlook 2014

United Nations Environment Programme

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South Asian Association for Regional Cooperation

The South Asian Association for Regional Cooperation (SAARC) provides a platform for the people 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.

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.

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 publication is printed with eco-friendly practices.

Foreword

SAARC Leaders and Member States, since the beginning, have attached high priority to regional cooperation in the conservation and protection of the environment. The policy directives emanating from SAARC Summits continue to provide the momentum for increasing and strengthening cooperation in the conservation and management of the environment. The periodic meetings of SAARC Environment Ministers and the Technical Committee of Environment and Forestry also guide and facilitate the agenda of cooperation amongst Member states.

A number of significant initiatives, such as the SAARC Plan of Action on Environment (1997), the Dhaka Declaration and SAARC Action Plan on Climate Change (2008), the Thimphu Statement of Climate Change (2011), the SAARC Convention on Environment (2011), etc. have been taken to enhance regional cooperation. The establishment of a number of Regional Centers such as the SAARC Meteorological Research Centre (Bangladesh), the SAARC Coastal Zone Management (Maldives), the SAARC Disaster Management Centre (India) and the SAARC Forestry Centre (Bhutan) constitute a framework of SAARC Institutions which address diverse aspects of environment and climate change related issues.

I am happy to note that the collaboration between SAARC and United Nations Environment Programme (UNEP) started with the signing of a Memorandum of Understanding (MoU) in 2007. Since then, the two organizations have implemented several activities (workshops, trainings, etc.) which have benefited SAARC Member States. The current MoU signed in 2014 is valid till 2019. In this context, I wish to acknowledge the technical and financial support of UNEP with appreciation. I am confident that SAARC-UNEP cooperation will continue to grow in the coming years.

I welcome the publication of the South Asia Environment Outlook (SAEO) 2014 by UNEP and Development Alternatives, New Delhi, after conducting training and holding consultation workshops for inputs from SAARC Member States. The SAEO 2014 provides useful information and data on the current status of the environment in the region. I am confident that it would enable all stakeholders, particularly leaders and authorities, to plan and formulate important policy and practical measures to address challenges in preserving, protecting and managing the diverse and fragile eco-systems of our region for the benefit of the present and future generations within and beyond SAARC.

Arjun Bahadur Thapa
Secretary General of SAARC

Foreword

UNEP
United Nations Environment Programme

The global community is engaged in a profound discussion on defining the crucial next phase of human development – a universal post-2015 sustainable development agenda and Sustainable Development Goals. In these discussions there is common acceptance that a healthy environment is necessary for eradicating poverty and supporting equitable economic growth and social progress.

In South Asia, as in many other parts of the world, environmental degradation is becoming so severe that it is undermining growth itself. The South Asia Environment Outlook 2014 report presents concrete evidence that food security, water security and the livelihoods of the people in South Asia are at risk due to climate change, air pollution and other environmental threats.

The South Asia Environment Outlook 2014 also signals some positive policy transformations that are in line with what we are seeing across Asia Pacific. Many more countries have in place green economy and green growth policies, and low carbon and low emission plans. Over half of global new investment in renewable power and fuels in 2013-14 was in Asia Pacific, including in South Asia. Many communities are also benefitting from investing in their natural resources to promote sustained growth, including through ecosystem restoration and ecosystem based adaptation. It is becoming increasingly clear that playing by the principles of a green economy-in the context of sustainable development and poverty eradication- will not hamper inclusive economic growth. It will drive it.

The South Asia Environment Outlook 2014 report was developed in partnership with the South Asian Association for Regional Cooperation (SAARC),its member countries and other institutions. It uses an integrated environmental assessment methodology developed for UNEP's Global Environment Outlook to analyze and present data and information on the state, trends and outlook of the environment in South Asian countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

I hope the findings of this report will help South Asian countries in the formulation of their post-2015 development agenda.

Kaveh Zahedi
Regional Director and Representative
for Asia and the Pacific
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A full list of names of individuals and institutions involved in the assessment process is included in the annexure.

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Contents

Acronyms

ABCs	Atmospheric Brown Clouds
ADB	Asian Development Bank
AEPC	Alternative Energy Promotion Centre
AKF	Aga Khan Foundation
AGY	Adarsh Gaon Yojana
AIA	Advance Informed Agreement
AIT	Asian Institute of Technology
AKP	Adaption Knowledge Platform
AOGCMs	Atmosphere-Ocean General Circulation Models
APSU	Arsenic Policy Support Unit
ARECOP	Asia Regional Cook-stove Programme
BAU	Business As Usual
BCCRF	Bangladesh Climate Change Resilience Fund
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BEE	Bureau of Energy Efficiency
BMW	Bio-Medical Waste
BORDA	Bremen Overseas Research and Development Association
BPL	Below Poverty Line
CANSA	Climate Action Network South Asia
CASE	Clean Air and Sustainable Environment
CBD	Convention on Biological Diversity
CBWTF	Common Bio-Medical Waste Treatment Facility
CCA	Climate Change Adaptation
CDM	Clean Development Mechanism
CDKN	Climate Development Knowledge Network
CEC	Chief Enforcement Coordinator
CEE	Centre for Environment Education
CEEP	Coordinated Environmental Education Project
CERs	Certified Emission Reductions
CERID	Research Centre for Innovation and Development
CETP	Common Effluent Treatment Plant
CITES	Convention on the Trade in Endangered Species
CMC	Cooperative Monitoring Centre
CMS	Convention on Migratory Species of Wild Animals
CO2	Carbon- dioxide
COP	Conference of Parties
CPCB	Central Pollution Control Board
CRT/N	Centre for Rural Technology, Nepal
CSC	Common Service Centres
CSGTs	Climate Smart Goods and Technologies
CSO	Civil Society Organisation
CSR	Corporate Social Responsibility
CTF	Clean Technology Fund
DA	Development Alternatives
DALYs	Disability Adjusted Life Years
DARE	Department of Agricultural Research and Education
DEEP	Daudpota Environmental Education Programme
DEITY	Department of Electronics and Information Technology
DHA	Docosahexaenoic acid
DMRC	Delhi Metro Rail Corporation
DNPWC	Department of National Parks and Wildlife Conservation
DPH	Department of Public Health
DPSIR	Drivers-Pressures-State-Impacts-Responses
DRR	Disaster Risk Reduction
EBA	Ecosystem based Adaptation
ECAs	Ecologically Critical Areas
ECBC	Energy Conservation Building Code
EGS	Employment Guarantee Scheme
EIA	Environment Impact Assessment
EKC	Environmental Kuznets Curve
ENVIS	Environmental Information System
EP	Essential Priority
EPA	Eicosapentaenoic acid
ESAP	Energy Sector Assistance Programme
ESV	Ecosystem Service Valuation
EU	European Union
FAO	Food and Agriculture Organization
FAOSTAT	FAO Statistics Division
FBS	Federal Bureau of Statistics
FCI	Food Corporation of India
FCPF	Forest Carbon Partnership Facility
FFE	Food for Education
FFW	Food for Work
FICCI	Federation of Indian Chambers of Commerce and Industry
FMU	Forests Management Units
FPC	Fair Price Card
FSC	Forest Stewardship Council
FSI	Forest Survey of India
FUG	Forest User Groups
GDP	Gross Domestic Product
GERES	Group Energies Renouveable, Environment et Solidarities

GEF	Global Environment Facility
GEO	Global Environment Outlook
GF	Gratuitous Relief
GHG	Greenhouse Gases
GIS	Geographical Information System
GLASOD	Global Assessment of Soil Degradation
GLOBE	Global Learning and Observations to Benefit the Environment
GLOF	Glacial Lake Outburst Floods
GMO	Genetically Modified Organism
GNI	Gross National Income
GNH	Gross National Happiness
GPA	Global Programme of Action
GRBMP	Ganga River Basin Management
HCFs	Health Care Facilities
HDI	Human Development Index
HKHT	Hindu Kush-Himalayan-Tibetan
HTAP	Hemispheric Transport of Air Pollution
IBA	Important Bird Areas
IBIS	Indus Basin Irrigation System
ICDDR, B	International Centre for Diarrhoeal Disease Research, Bangladesh
ICIMOD	International Centre for Integrated Mountain Development
ICS	Improved Cookstoves
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IEA	International Energy Agency
IEA	Integrated Environment Assessment
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IHR	Indian Himalayan Region
IMF	International Monetary Fund
INCCA	Indian Network for Climate Change Assessment
IPAs	Important Plant Areas
IPAM	Implementation Plan for Arsenic Mitigation
IPCC	Inter-governmental Panel on Climate Change
IRADe	Integrated Research and Action for Development
ISRO	Indian Space Research Organization
IUCN	International Union for Conservation of Nature
IWMI	International Water Management Institute
IWMP	Integrated Watershed Management Programme
IWRM	International Water Resource Management
JFM	Joint Forest Management Programme
JI	Joint Implementation
JNNURM	Jawaharlal Nehru National Urban Renewable Mission
KNN	Kanpur Nagar Nigam
KP	Khyber Pakhtunkhwa
LDCs	Least Developed Countries
LEAD	Leadership for Environment and Development
LeDG	Ladakh Ecological Development Group
LEI	Large Employee Industries
LMOs	Living Modified Organisms
LOCAL	Local Climate Adaptive Living Facility
MAB	Man and Biosphere Programme
MAIL	Ministry of Agriculture, Irrigation and Livestock
MBI	Market-based Instruments
MDGs	Millennium Development Goals
MEA	Millennium Ecosystem Assessment
MFF	Mangroves for the Future
MoA	Memorandum of Agreement
MoEA	Ministry of Economic Affairs
MoEF & CC	Ministry of Environment , Forests and Climate Change
MoEST	Ministry of Environment, Science and Technology
MOSPI	Ministry of Statistics and Programme Implementation
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MSME	Ministry of Micro, Small and Medium Enterprises
MSW	Municipal Solid Waste
NAMP	National Air Quality Monitoring Programme
NAPA	National Adaptation Programme of Action
NAPCC	National Action Plan on Climate Change
NATP	National Agriculture Technology Project
NBA	National Biodiversity Authority
NBSAPs	National Biodiversity Strategy and Action Plans
NCAER CGE	National Computational General Equilibrium Model
NEAC	National Environment Awareness Campaign
NEC	National Environment Commission
NECS	National Environment Commission Secretariat
NEERI	National Environmental Engineering Research Institute
NeGP	National e-Governance Plan
NEPA	National Environment Protection Agency
NETTLAP	Network for Environmental Training at Tertiary Level in Asia and the Pacific
NFE	Non-Formal Education

NFC	Nepal Food Corporation
NGC	National Green Corps
NGOs	Non-governmental Organizations
NGRBA	National Ganga River Basin Authority
NMSHE	National Mission for Sustaining the Himalayan Ecosystem
NOX	Nitrogen Oxides
NRW	Non-Revenue Water
NSB	National Statistics Bureau
NTP	National Tariff Policy
O3	Ozone
OMS	Open Market Sales
OP	Other Priority
PAs	Protected Areas
PAT	Perform, Achieve and Trade
PBS	Pakistan Bureau of Statistics
PCRET	Pakistan Council for Renewable Energy Technologies
PCRWR	Pakistan Council for Research in Water Resources
PDS	Public Distribution System
PEFC	Programme for the Endorsement of Forest Certification
PEI	Poverty Environment Initiative
PES	Payment for Ecosystem Services
PET	Polyethylene Terephthalate
PFDS	Public Foodgrain Distribution System
PHC	Polycyclic Aromatic Hydrocarbons
PM	Particulate Matter
PwC	Pricewaterhouse Coopers
RBI	Reserve Bank of India
RCP	Representative Concentration Pathways
R&D	Research and Development
RDF	Refuse Derived Fuel
REDD	Reducing Emissions from Deforestation and Forest Degradation
RPO	Renewable Purchase Obligation
SAARC	South Asian Association for Regional Cooperation
SACEP	South Asian Cooperative Environment Programme
SACRTF	South Asia Coral Reef Task Force
SAFTA	South Asia Free Trade Agreement
SAPTA	South Asia Preferential Trade Agreement
SAS	South Asian Seas Programme
SASAP	South Asian Seas Action Plan
SATNET	Sustainable Agricultural Technologies and Improved Market Linkages in South and Southeast Asia
SAYEN	South Asia Youth Environment Network
SAWAN	South Asia Water Analysis Network
SAWEN	South Asia Wildlife Enforcement Network
SAWGP	South Asia Water Governance Programme
SAWI	South Asia Water Initiative
SCENGEN	Scenario Generator
SCP	Sustainable Consumption and Production
SCWAM	Supreme Council for Water Affairs Management
SDC	Swiss Development Cooperation
SEBS	Science Express Biodiversity Special
SFD	State Forest Departments
SLM	Sustainable Land Management
SOX	Sulphur Oxides
SPCB	State Pollution Control Board
SPM	Sustainable Particulate Matter
SRES	Special Report on Emission Scenarios
TA	Technical Assistance
TARWR	Total Actual Renewable Water Resources
TEEB	The Economics of Ecosystem and Biodiversity
TERI	The Energy Research Institute
TPA	Transboundary Protected Areas
TR	Test Relief
TSDFs	Treatment Storage and Disposal Facilities
ULBs	Urban Local Bodies
UNCDF	United Nations Capital Development Fund
UNCED	United Nations Conference on Environment and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-WCMC	United Nations Environment Programme -World Conservation Monitoring Centre
UNESCAP	United Nations Economic and Social Commission for Asia and Pacific
UNESCO	United Nations Educational Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
VAT	Value Added Tax
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WGP	World Gross Product

List of Boxes

List of Figures

List of Tables

Introduction to SAEO 2014

The South Asia Association for Regional Cooperation (SAARC) and the United Nations Environment Programme (UNEP) signed a Memorandum of Understanding (MoU) in 2007, providing a policy framework for meaningful collaboration to develop the South Asia Environment Outlook report based on UNEP's integrated environmental assessment (IEA) methodology and the use of credible scientific data and information in the preparation of the report.

UNEP and the Society for Development Alternatives in India (DA) agreed to cooperate in the development of the South Asia Environment Outlook 2014 (SAEO 2014). The aim of this collaboration was to review the current environmental state, trends and changes, and analyze successful policies which can support transition to a green economy in the South Asia.

The major objectives of SAEO 2014 are to:

- Present and analyze the most up-to-date data and information on current environmental conditions and trends in the SAARC member countries;
- Identify driving forces and pressures influencing environmental change, and emerging environmental issues;
- Analyze existing policy responses, with a particular focus on identifying successful policies, including if possible exploring possible future scenarios, subject to availability of technical and financial resources;
- Develop policy options for action planning, policy settings and resource allocations towards environmental sustainability;
- Provide data and information that can contribute to regional and global environmental reporting initiatives such as the South Asia Environmental Data and Information System and the UNEP-Live platform.

SAEO 2014 is structured into 6 sections: Regional Overview; Drivers of Change; State and Trends of Environment; Key Priority Issues; Scenarios and Outlooks and Conclusions and Options for Action.

SAEO 2014 is based on the drivers, pressures, state, impacts and responses (DPSIR) framework. The DPSIR framework is an extension of the Pressure-State-Response (PSR) model of UNEP's integrated environmental assessment (IEA) methodology. The DPSIR framework focuses on what has gone wrong with the environment and how to fix it. According to the DPSIR framework there is a chain of causal links starting with '*driving forces*' (economic sectors, human activities) through '*pressures*' (emissions, waste) to '*state*' (physical, chemical and biological) and '*impacts*' on ecosystems, human health and functions, eventually leading to political '*responses*' (prioritization, target setting, indicators).

Executive Summary

With the aim of keeping the stakeholders and governments informed on the state and trends of environment, the United Nations Environment Programme (UNEP) develops the Global Environment Outlook (GEO). It is a consultative, participatory process that builds capacity for conducting integrated environmental assessments for reporting on the state, trends and outlooks of the environment. Similarly, South Asia Environment Outlook 2014 is a result of a consultative process with governments and other partners from countries of South Asia, regional intergovernmental agencies and experts.

South Asia Environment Outlook 2014 highlights the state and trends of the environment of South Asian countries i.e. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, including the emerging trends. It also elaborates on five key issues – (1) Climate Change, (2) Water Security, (3) Urban Environment, (4) Food Security and (5) Energy Security.

The report is structured into six sections:

Section I: Regional Overview

This section presents a brief profile of the region with characteristics of bio-physical profile, socio-economic and cultural pattern, climate and economic base and the governance in the region. The topography of the region includes a variety of mountains, plateaus, dry regions, river basins and beaches. The other key geographical features include the Indo-Gangetic plains, large expanses of wetlands and coral reefs, islands like Andaman, Nicobar and Lakshadweep as well as island countries like Maldives and Sri Lanka. The region is also home to the world's highest point, Mount Everest. The coastline of South Asia runs to about 11,682 km from Pakistan to Bangladesh. Some of the world's largest river systems (i.e. Ganga, Indus and Brahmaputra basins) are found in the region, forming the cultural and economic backbone of South Asia. The region is characterized by a tropical monsoon climate. Two monsoon systems operate in the region: the south-west or summer monsoon (June-September) and the north-east or winter monsoon (December-April). The monsoon rainfall in South Asia has witnessed large variations, increasing the incidences of disasters such as floods and droughts.

South Asia is an amalgamation of myriad multi-cultural ethnic, religious or linguistic groups that have a common bond to their own heritage, culture, values and ways of life. Globally, the region is also a key economic zone. The region had attained more than seven percent growth since 2003, alleviating poverty levels in Bangladesh, India and Pakistan. However, this growth has seen a decline since 2011. Despite the economic progress, poverty is still a widespread problem with the bulk of the poor living in rural areas. World Bank estimates reveal that 398.95 million people lived below the poverty line in 2011.

The South Asian countries face several environmental issues. The region is plagued by environmental threats such as climate change, land degradation and deforestation, air and water pollution, and loss of biodiversity. Poverty and human development are also linked to the environmental priorities of the region. The Human Development Index (HDI) combines social and economic development in a single frame. Unfortunately, South Asia had one of the lowest HDI values, i.e. 0.558 in the world, higher only than that of Sub-Saharan Africa.

Realizing the threat of environment degradation, countries are taking several measures to protect the environment. Regional cooperation is crucial to the success of these measures. In the context of regional cooperation on environmental issues the efforts of two inter-governmental i.e. the South Asian Association for Regional Cooperation (SAARC) and the South Asian Cooperative Environment Programme (SACEP) are commendable.

Section II: Drivers of Change

This section highlights the major drivers of environmental change in South Asia: population growth, urbanization, economic development and climate change. They degrade the environment through uncontrolled urbanization and industrialization; expansion and intensification of agriculture; and, destruction of natural habitats.

Though South Asia occupies only 4.8 percent of the world's land mass, it is home to a diverse population of 1.67 billion. India is the most populated country in the region, followed by Pakistan. Countries like Bhutan and Maldives are comparatively less populated than other South Asian countries. The current population explosion is a result of the past population boost.

Migration is a component of demographic transition. Rural to urban migration has been continually on the rise. This pattern of migration can be attributed to the increase in

economic opportunities in urban areas. South Asia is in the midst of rapid transformation from a predominantly rural to urban society. The region has seen an upward trend in terms of the urban population, with an annual growth rate of 2.52 percent. Delhi, Mumbai, Kolkata, Dhaka and Karachi were among the largest agglomerates in the world in 2011.

Population growth and demographic transitions are directly related to the key issues of the region like land degradation, resource depletion, food security, deteriorating air quality and loss of biodiversity. Biodiversity loss can be attributed to human induced elements like habitat loss and fragmentation; introduction of invasive alien species; and, homogenization of species in agriculture. The current population boom, along with higher consumption lifestyles, is putting tremendous pressure on the water availability and quality. Reduced access to water is bound to have cascading effects such as reduced food production, loss of livelihood security and large-scale migration within and across borders. The quality of freshwater and groundwater has also decreased due to industrial effluents, domestic waste water, land-use run-offs and leaching from mine tailing as well as solid waste dumps. The arsenic contamination in groundwater in the Ganga-Brahmaputra fluvial plains in India, Padma-Meghna fluvial plains in Bangladesh and the north-central part of Sri Lanka can be attributed to excessive extraction of groundwater for human use. Land is also under pressure due to intensification of agriculture and rampant water withdrawals, coupled with deforestation. Urbanization and industrialization generate air pollutants like sulphur oxides (SO_x), nitrogen oxides (NO_x) and particulate matter.

Economic development and industrialization are inevitable for the growth of developing countries. This growth itself has positive as well as negative impacts on the environment. Industrialization, coupled with rapid urbanization, has led to a huge increase in demand in terms of materials and energy. The changing consumption and production patterns and technologies, with the advent of affluence and infrastructure development, have contributed to the degradation of the natural resource base. Apart from the pressure on resources, industrialization also drives changes in land use. Subsidies supporting production, transport or consumption can also have unintended negative impacts on the environment.

Lastly, climate change is one of the biggest threats to economic and social development. The main causes of climate change are the increasing concentration of greenhouse gases (like carbon dioxide, methane, nitrous oxide, fluorinated gases) and land-use changes for urban and human settlement purposes. South Asia has witnessed an increase in carbon dioxide emissions over the years. Its effects include changes in the rainfall patterns, culminating into severe water shortages, flooding, melting of glaciers (causing flooding and soil erosion), and rising temperatures, affecting food security and accelerating the annihilation of a huge number of habitats and species. In fact, rising temperatures can cause a rise in the sea level, leading to a greater risk of storm surge, inundation and wave damage to the coastline.

Section III: State and Trends of Environment

This section presents the state of environment, along with the trends and integrated analyses of four major themes (Land, Air, Water and Biodiversity). The state and trends have been analyzed under the Pressures-State-Impacts-Responses (PSIR) framework.

Land

Being an agrarian region, agriculture is the predominant form of land use in South Asia. Total agricultural land accounted 48 percent of total land area in 2012. On the other hand, arable land accounted for 34 percent of the land area. The proportion of arable land varies greatly across the region, from the lowest in Bhutan to the highest in Bangladesh. However, there has been no drastic change in the area under agriculture between 2006 and 2011. With the emphasis on improving production and yields, agricultural practices have progressed. These can be seen through the net increase in the area under irrigation, growth in fertilizer and pesticide consumption, and the use of high yielding variety of seeds. The total nitrogen and phosphate fertilizer usage on arable and permanent crop area increased in Bhutan, India, Nepal and Pakistan during 2006-2010. The highest increase was observed in India where consumption increased from 113.9 to 144.8 kg per hectares during 2006 to 2010. Though inefficient, the traditional method of flood irrigation is still prevalent in most parts of South Asia. Only 2.2 percent of the agricultural area use efficient irrigation techniques. These methods have detrimental effects on land quality. Inefficient irrigation also contributes to water-logging, leaching, and soil salinization, which is wreaking havoc in countries like Bangladesh, India, Pakistan and Sri Lanka.

The percentage of forest cover is South Asia varies widely with the highest in Bhutan (85.8 percent of land area) and lowest in Afghanistan (two percent of land area). The forests of the region are threatened by deforestation,

stemming from the population pressure. Forest fires and grazing pressures are also some of the real dangers threatening the existence of the South Asian forests.

Land degradation is another major problem in all countries. Afghanistan and Bhutan, due to their rugged topography and altitude, have limited resources in terms of productive land. 16 percent of the land area of Afghanistan is severely affected due to anthropogenic activities. Afghanistan, India, Nepal and Pakistan are also highly vulnerable to desertification. 75 percent of Afghanistan's northern, western and southern regions is affected by desertification. 28.24 percent of land in Nepal is also affected by desertification. On the other hand, coastal erosion is the main land degradation problem faced by Maldives. Beach erosion is a serious problem in about 50 percent of the atoll islands. Responses to land degradation and forest loss include watershed programmes, afforestation programmes, awareness and capacity building programmes among others.

Air

Vehicular emission is the largest source of air pollution, especially in urban areas. The number of vehicles in the region is growing at a fast pace. The total number of registered motor vehicles has increased by approximately 65 percent during 2001-2012 in India. Urban growth and industrialization have caused air pollution to become a real concern. Increasing concentrations of pollutants like particulate matter and NO_x have been recorded in the region. On the other hand, SO_2 emissions have decreased over the last few years, especially in India. South Asia has also witnessed a uniform increase of surface ozone of about 0.25 ppbv per year. A steady increase in the concentration of CO_2 has also been observed. The emissions have increased by 24 percent from 2006 to 2010. India is the biggest contributor to the CO_2 emissions. The other countries contribute merely 10.82 percent of the emissions of the region. However, the per capita emissions of the region are still far below the world average.

Air pollutants have multiple effects on the atmosphere, terrestrial ecosystems, freshwater and marine systems, as well as on human health. Outdoor air pollution was estimated to account for approximately 1.4 percent of the total mortality. Actually, ground-level ozone is one of the major contributors to smog whose intensity has increased in the Indo-Gangetic plains in the last few years. Widespread layers of brownish haze, termed as atmospheric brown clouds (ABCs), have also been observed. Increase in the concentration of greenhouse gases in the atmosphere contributes to global warming and climate change, which is one of the most serious threats to the planet today.

Indoor air pollution is yet another grave problem threatening the South Asian countries, stemming from their heavy dependence on solid fuels. The rise in health problems and environmental impacts due to dirty cooking fuels is driving South Asia to look for alternative household fuels; to set new targets for access to modern fuels; and design policies for a swifter transition to cleaner fuels and stoves.

High levels of urban air pollution have attracted the attention of governments, civil society, and industry in South Asian countries. Measures taken by various countries to mitigate air pollution include introducing vehicular emission standards; vehicular emission testing; industrial emission and discharge standards; improving the efficiency of industrial and energy sectors; and, enhancing the forest area to reduce the emissions. Bhutan and Maldives have committed to make their country carbon neutral in the near future.

Water

Freshwater is a finite and vulnerable natural resource catering to the needs of multiple stakeholders for a range of purposes such as domestic water supply, irrigation, hydropower and industrial production. Though home to one-fourth of the world's population, South Asia contains merely 4.5 percent of the world's annual renewable water resources. Given the large population of the region and its economic growth, the water withdrawals are also high. The consumption of water in the region is driven by a few major sectors like agriculture, industry, energy, and human settlements. As a matter of fact, the agriculture sector has a large water footprint in comparison to the other sectors. The water flows in the region is also diminishing due to glacial melt. A decrease of 24 percent in the total glacier area was observed between 1977 and 2010 in Nepal. Bhutan and India are also affected by glacial melt.

Groundwater is a significant resource for consumption, with Bangladesh, India and Pakistan as some of its major consumers. In fact, depletion of groundwater is bound to have profound impacts on human welfare and ecosystems. The ever increasing threat of water scarcity can be visualized by the fact that except for Bhutan and Nepal, the per capita water availability in the region is less than the world average. The threat is further compounded by the diminishing water flows due to glacial melt.

The water quality is threatened by pollution from agricultural and urban areas, solid waste, and industrial effluent along with other contaminants. Apart from arsenic contamination in groundwater, pathogenic contamination of surface and groundwater in South Asia also poses critical threat to human health, wherein the major sources of pathogens are human and animal faeces and domestic sewage.

Biodiversity

The South Asian region is renowned for its biological wealth and diverse ecosystems. Four global biodiversity hotspots (i.e. Western Ghats, Sri Lanka, eastern Himalayas, Indo-Burma and Sundaland) can be found in the region.

It is also home to the mountains of the Hindu-Kush-Himalayas, the Thar Desert, the Sundarbans and the coral reefs and atolls of Maldives. Forests range from montane, tropical rainforests, sub-tropical forests to coastal and temperate forests. 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. It has one of the world's finest coral ecosystems, including atolls along the Lakshadweep-Maldives-Chagos ridge, fringing and patch reefs in Andaman and Nicobar Islands, near the Gulf of Mannar in India and Sri Lanka and along the south-western and eastern coastline of Sri Lanka.

South Asia also has a high percentage of protected areas (PA), especially Bhutan (51.4 percent) and Sri Lanka (28 percent). In comparison, Afghanistan and Bangladesh have negligible areas assigned as PAs. Trans-boundary protected areas (TPAs) are also gaining importance as many zones of high biodiversity are located along borders.

The factors contributing to loss of biodiversity in the region are habitat loss and fragmentation, overexploitation of natural resources, climate change, invasive alien species and illegal trade among others.

Section IV: Key Priority Issues

Section IV focuses on the key environmental issues of climate change, water security, urban environment, food and energy security that threaten to cripple the efforts towards the holistic development of South Asia.

Climate Change

The observed climatic trends of the South Asian region are characterized by the increasing surface air temperatures. Variability in the annual and seasonal precipitation has been observed during the past few decades, culminating in frequent extreme climatic events. The frequency of occurrence of intense rainfall events has increased, causing severe landslides, floods and debris and mud flows. The intensity and frequency of droughts has also increased in many parts of the region.

Apart from floods and droughts, the population of the region is threatened by Glacial Lake Outburst Floods (GLOF) and coastal inundation due to the sea level rise. The scale of threat could be imagined by the destruction caused by the Uttarakhand disaster in 2013. Climate change has disproportionate impacts on the community. It has varied impacts on agriculture, hydrology and water resources, biodiversity and human health.

In order to address climate change, a few measures are illustrated below:

- Assess vulnerability to climate change, and build the capacity of the countries to carry out these assessments;
- Integrate climate change issues in local-level planning processes;
- Disaster preparedness should be strengthened for effective response and recovery at all levels, from the local to the national. The resilience of communities should also be developed;
- Loss and damage should be addressed as a stand-alone issue;
- Innovative financing needs to be implemented, including carbon tax, emissions trading, feed-in tariffs and REDD+ (Reducing Emissions from Deforestation and Forest Degradation);
- Dissemination of climate smart goods should be done through sustainable trade and investment; and
- '*No regret'* or '*low regret*' adaptation options should be adopted.

Water Security

Water security is an extremely vital issue for the South Asian region. Many countries are experiencing water scarcity, owing to the simultaneous effects of agricultural growth, industrialization, urbanization and population growth. Other issues like pollution, receding glaciers, climate change and other bio-physical vulnerabilities aggravate the water shortage.

Access to safe drinking water and sanitation remains a

major challenge, despite its tremendous progress in the last two decades. Bangladesh and India have a lot of ground to cover in terms of providing people with safe drinking water.

Some of the measures to enhance water security are:

- Formulation of effective water policies is a must for proper management of water resources. Groundwater withdrawals should be regulated. Policy changes like building rainwater harvesting structures in semi-arid and arid regions should be promoted;
- Trans-boundary water sharing will play a crucial role in enhancing water security as countries like Bangladesh, Bhutan, India, Nepal and Pakistan share 20 major rivers. Development of large river basins needs consensus building and arriving at agreements though negotiations for sharing the resources within a country or with other countries;
- Integrated water management is probably the best approach to manage and conserve water for all; maintain ecological balance; and, build resilience against climate change;
- Improving efficiency and minimizing water loss, especially in agriculture systems, goes a long way in conserving water; and
- Policies should be made to regulate water pricing.

Urban Environment

South Asia is in the midst of a transformation from a predominantly rural to an urban society. In 2011, 32.6 percent of the population resided in urban areas. The expanding urban population is putting severe strain on the urban infrastructure. Cities are unable to cope with the demands of basic civic amenities. Sanitation and solid waste management are some of the grave problems in South Asia. Growing urbanization has also led to unchecked construction of houses without integrating environmental aspects in terms of the choice of construction sites, construction materials etc. The demand of the construction sector on natural resources leads to injudicious extraction from rivers, quarries and clay pits.

For effective management of future urbanization, we all must realize that sustainable urbanization is pivotal for sustainable development. Cities need to be planned, designed and developed to lessen their impact on the environment; be resilient to the effects of climate change; and contribute to the nation's economic growth. The role of communities, business and local authorities in developing and implementing strategies and plans for sustainable urban development should be recognized. The capacity of urban local bodies should be enhanced for effective decentralization.

Energy Security

South Asia is heavily dependent on fossil fuels to fulfill its energy requirements. Bhutan is an exception as it makes use of hydropower. Despite the increase in production of energy, the supply is much less than the demand. As a result, Bhutan, Maldives, Nepal and Sri Lanka are dependent on the import of fossil fuels to meet their requirements.

Energy Access is crucial for human development in any country. Access to electricity varies across the region. Bhutan has the highest level of electrification. In contrast, Afghanistan has the lowest level of electrification. Access to energy can also be measured in terms of use of cook stoves or appliances that rely on traditional sources, yet exhibit efficiency. About 69 percent of South Asian population relied on traditional biomass for cooking in 2010.

Some of the measures to enhance energy security are:

- Diversification of energy mix ;
- Increase in the share of renewable energy;
- Regional cooperation to exploit the hydropower potential in the region and;
- Introduction of energy efficient practices to reduce transmission and distribution losses.

Food Security

Food security is of prime importance for the region. It is not simply linked to health but also to sustainable economic development, environment and trade. South Asian countries are heavily dependent on agriculture, not only for their consumption but also for the sustainable livelihoods of the poor. Economic growth has contributed to the reduction of food insecurity in the region. It has translated into increased dietary energy demand and supply. Slight changes have also been observed in the composition of diets. There has been a growth in the consumption of animal source goods. However, despite economic development, the number of undernourished people are still unacceptably high. A considerable portion of the South Asian population, especially in Afghanistan, suffers from inadequate food intake.

The major pressures on food security include poverty, land degradation, intensive farming, climate change and food price hike.

Some of the measures to ensure food security are:

- Research and development for enhancing agricultural productivity;
- Promoting a cocktail of agricultural practices like conservation agriculture, high yielding cultivars and efficient use of fertilizers;
- Enhancing efficiency along the food chain by reducing food waste and spoilage;
- Encouraging conditional food programmes;
- Transferring cash to consumers in need;
- Utilizing food reserves and banks as alternatives for increasing food security in the region and;
- Exploring the role of trade in food commodities to ensure food security.

Section V: Scenarios and Outlook

This section describes the possible state of key drives and issues in the future. These scenarios would certainly help in understanding the kind of policy changes required for a sustainable world.

The population of South Asia is likely to cross the 3.5 billion mark by 2100, with the maximum growth in cities and towns. The urban population is expected to grow to 1.2 billion by 2050. At the same time, increase in GDP will also be observed. In fact, India is set to become one of the largest economies of the world by 2050.

Population growth and economic development will lead to detrimental effects on the environment. GHG emissions determined by various driving forces like demographics, socio-economic development and technological advancement. As a result of increased emissions, a likely increase in surface air temperature has been predicted. RCP8.5 scenario predicts an increase of average annual temperature by more than 2ºC in most of South Asia by the mid 21st century. In general, projected warming over South Asia is higher during winters than during summers for all time periods. IPCC has also predicted an increase in the annual precipitation during the century. A significant increase in the number of extreme weather events has also been projected. These weather events also include heat wave, intense precipitation events and an increase in the inter-annual variability of daily precipitation in the Asian summer monsoon. The sea level rise will affect the coastal population of Bangladesh, India, Maldives and Sri Lanka.

Scenarios on other issues like water stress, land-use change and food security are also described. These scenarios predict South Asia to be severely water stressed by 2050. On the other hand, land-use changes are not so easy to predict through models. Various scenarios predict the changes in forest area. The Millennium Ecosystem Assessment predicts a decrease in the forest area until 2050. It is also perceived that there will be little expansion of arable land in land scarce regions.

In terms of food security, food demand will increase due to increased urbanization and population growth. It will also result in reduced supply due to limited availability of cropland area and decreased yield. The preference for livestock products is also likely to increase. Despite the economic development, the risk of hunger is still likely to remain high in the near future.

Section VI: Options for Environmental Action

This section presents the various cross-cutting options to address the emerging challenges in the region.

Ecosystem-based adaptation should be integrated throughout the decision making process as it would certainly facilitate in adapting to climate change. It is also important to integrate ecological understanding and economic considerations. Ecosystem service valuation is an excellent tool to establish a link between the services provided by an ecosystem and its goods and services and its valuation by individuals. At the same time, innovative financing mechanisms that provide incentives to communities to remain engaged in conservation should also be explored.

The role of trade and investment in environment protection can not be denied. The transfer of environmentally sound technologies and climate smart goods is crucial. At the same time, national governments can promote sustainable and responsible business through Corporate Social Responsibility (CSR).

Emphasis must be placed on increasing the stakeholder's responsibility and accountability and promoting cooperative efforts for ensuring a healthy environment. Raising awareness and empowering people to take decisions is effective in terms of dealing with the environmental issues. It is also imperative to actively involve the youth in the decision-making process. The role of youth can be institutionalized in policy making through advisory bodies such as youth councils. Also, the role of SAYEN should be formalized to support youth involvement. Involvement of communities in the decision making (i.e. participatory approach) process is an excellent mechanism

to solve various issues. Community-based natural resource management initiatives, combined with policy reforms, are effective in managing resources.

Environmental governance at the national, regional and global level is critical for sustainable development. Strengthened environmental governance is extremely crucial to effectively address the emerging challenges and priorities. The vision of sustainable development should be integrated in the planning process. This requires proper coordination between different ministries and agencies involved in the process of planning and implementation of various inter-related policies.

The need of the hour is capacity building of environment and related ministries and agencies for mainstreaming sustainable development, supported by decentralization. All these efforts should be complemented by accurate, reliable and timely information. Lack of accurate information hampers the formulation and implementation of policies/schemes. The decision-making process of the region has been hampered by data gaps. In order to address this issue, a regional environmental and information system should be developed, comprising statistics of all related sectors. This system should strengthen data sharing among countries for addressing trans-boundary issues.

The role of regional cooperation in addressing the trans-boundary issues is also crucial. Implementation of the initiatives taken by SAARC and SACEP needs to be strengthened. Appropriate human resource and infrastructure should be committed to strengthen these initiatives. Apart from this, sharing of best practices with respect to policies, programmes and schemes should be encouraged.

Regional Overview

Chapter 1

Photo Credit: Tshering Tashi

The South Asia sub-region encompasses eight countries: namely, "Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka". This Regional Overview presents a brief profile of the region. Apart from its bio-physical profile and cultural patterns, this section also highlights the aspects of economic development and governance in the region. It also brings to light the key environmental challenges and human development issues of the region.

South Asia is home to one of the oldest civilizations of the world. The region encompasses eight countries: "Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka". The region's geographical expanse includes a variety of mountains, plateaus, dry regions, river basins and beaches. The South Asian region is characterized by the diversity of its natural and cultural heritage. This region has 54 sites in the World Heritage List. The culture of the region comprises its art, cuisine, music, literature, philosophy, and religions. It has approximately 1.67 billion population, growing at the rate of 1.31 percent per annum, but has only 4.8 percent of the world's total land area (World Bank 2013a).

South Asia is a key economic zone, as seen from the global perspective. The region had averaged more than 7.0 percent growth since 2003, allowing it to reduce poverty levels in India, Pakistan, and Bangladesh. However, this growth has seen a decline since 2011. The Gross Domestic Product (GDP) growth rate dropped to 5.19 percent in 2013 from 9.13 percent in 2010 (World Bank 2013b). The Gross National Income (GNI) per capita has been gradually increasing over the years. It was estimated that GNI per capita of the region in 2013 was US$ 1058.18 (2005 constant), an increase of 3.71 percent from 2012 (World Bank 2013c). Despite the economic progress, poverty is still a widespread problem with the bulk of the poor living in rural areas. According to the World Bank estimates, the population of people living below the poverty line was 398.95 million in 2011[1]. Along with poverty and inequality, accelerating population growth rates, large-scale rural to urban migration and dwindling resource base also contribute to the destruction of fragile ecosystems.

1.1 Physiography and Relief

The region is bound in the south by the Indian Ocean, in the south-east by the Bay of Bengal, in the south-west by the Arabian Sea and in the north by the Himalayan Mountains. It occupies a major portion of the Indo-Malayan realm and a smaller portion of the Palaearctic realm. Apart from the Himalayas and the ocean system, other key geographical features include the Indo-Gangetic plain, the perennial river systems, large expanses of wetlands and coral reefs, islands like Andaman and Nicobar and Lakshadweep as well as the island countries of Maldives and Sri Lanka. This region is home to the world's highest point, Mount Everest.

Mountains: South Asia 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 north-west, across the northern part of the Indian subcontinent in an arc. The Himalayan mountains span across different countries like Afghanistan, Pakistan, India, Nepal and Bhutan. They include ranges such as Mount Everest (8,848 m[2]), K2 (8,611 m) (Ministry of Environment 2009), Kanchenjunga (8,586 m), Lhotse (8,516 m), Makalu (8,463 m), Dhaulagiri (8,167 m), Manaslu (8,613 m), Nanga Parbat (8,125 m) and Annapurna (8,091 m) (Ministry of Culture, Tourism and Civil Aviation 2013).

Photo 1: Mt. Everest, the Highest Peak in the World

Photo Credit: ICIMOD

1 http://iresearch.worldbank.org/PovcalNet/index.htm?
2 www.nationalgeographic.com

River systems: Some of the world's largest river systems are found in the region, forming the cultural and economic backbone of South Asia. The Ganga, Indus and Brahmaputra rivers are the three major river basins of the region. They support rich ecosystems and are a major source of irrigation. The River Indus originates in China and flows to Pakistan. It travels a distance of 3,180 km before it drains into the sea. The Ganga-Brahmaputra river systems originate partly in Bhutan, China and Nepal and flow to Bangladesh and India. Ganga has an economic, social and cultural importance for the people of Bangladesh and India. Originating in the Central Himalayas, the Ganga stretches for about 2,525 km and the Brahmaputra, the third great Himalayan river-stretches for about 2,900 km flowing through China, India and Bangladesh (UNEP and DA 2009). Many minor rivers that originate from the Himalayas and drain into the Bay of Bengal flow through Bangladesh, Bhutan, Nepal and India. Along with Ganga, Brahmaputra and Meghna are the two other major rivers in Bangladesh. The four major river basins in Bhutan are Amo Chu, Wang Chu, Punatsang Chu and Drangme Chu. Most of the rivers in Sri Lanka originate in the central mountains and flow radially. An exception to this is the Mahaweli River, the longest river in the country. Maldives does not have any river.

Photo 2: Rivers-Water Resource for Millions of People

Photo Credit: Development Alternatives

Coastal Regions: Afghanistan, Bhutan and Nepal are the landlocked countries. Bangladesh, India, Maldives, Pakistan and Sri Lanka are coastal countries. The length of the coastline of the region is 11,682 km.

Table 1: The Coastline of South Asia

Country	Length of the Coastline (km)
Bangladesh	710
India	7,517
Maldives	820
Pakistan	1,050
Sri Lanka	1,585
Total	11,682

Source: www.india.gov.in, www.pak.gov.pk, BBS (2009), Ministry of Environment and Energy (2011), Ministry of Environment (2011).

The islands in Bangladesh are scattered across the Bay of Bengal or in the river Padma. Major ones include Dublar Char, Bhola Island (largest island in the country), Sandwip, Hatiya, Manpura Island, St. Martin's Island, Kutubdia, Maheshkhali, Sonadia, and Urichar. As depicted in the table, India has a coastline of 7,517 km. Of this, 5,423 km belongs to peninsular India, and 2,094 km to the Andaman and Nicobar and Lakshadweep Islands. The mainland coast consists of sandy beaches (43 percent), rocky coast including cliffs (11 percent), and mud flats or marshy coast (46 percent) (MoEF&CC 2009). Maldives comprises 1,190 islands which are grouped into 26 atolls that cover an area of more than 90,000 km^2 in the Indian Ocean (Ministry of Environment and Energy 2011). Sri Lanka is located about 80 km south-east of the Indian sub-continent. Its coastline comprises sandy beaches and sand dunes, lagoons, estuaries, marshes, mangroves and deltas. In all, 113 islands can be found in Sri Lanka's territorial waters (Ministry of Environment 2011).

These regions are home to some of the largest and biologically rich marine ecosystems, such as the Gulf of Mannar, Atolls of Maldives and Mangroves of Sundarbans. It also has one of the world's finest coral ecosystems, with atolls constituting the entire country of Maldives. Lakshadweep and Nicobar group of islands and a few regions of Sri Lanka have fringing reefs.

1.2 Climate

The region is characterized by a tropical monsoon climate. Two monsoon systems operate in the region: the south-west or summer monsoon (June-September) and the north-east 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 [north-east] monsoon is dominant); and forms the chief source of water for agriculture and other activities.

The monsoon rainfall is characterized by large spatial and temporal variability. The arid and semi-arid region encompassing Pakistan and north-west India receive monsoon rainfall as low as 50 mm, while parts of north-east India and the west coast receive over 1,000 mm. This region also features large year-to-year variations in rainfall, frequently causing severe floods/droughts over large areas. There are two major anomalous regions: the arid and semi-arid parts comprising large areas of Afghanistan Pakistan, and north-western 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 experience frequent floods.

Table 2: Number of Climate Disasters in South Asia from 2005-2014

Country	Number of Flood Events	Number of Drought Events
Afghanistan	41	3
Bangladesh	16	1
India	93	1
Maldives	1	--
Nepal	14	2
Pakistan	35	--
Sri Lanka	20	1

Source: EM-DAT (2014[3])

The incidences of climate disaster like floods and droughts have increased in the recent times as evident from Table 2. Bhutan has witnessed many floods in the recent years, of which three major ones occurred in May 2009, June 2011 and 2013. The flood in 2009 occurred due to Cyclone Lila. 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 percent below normal; and in 10 of these 30 cases, drought conditions prevailed over India. During the same period, there were 16 La Niña years. According to the Pakistan Meteorological Department, 11 drought years could be attributed to El Nino (between 1871 and 1988) in Pakistan. India also faced its first drought in three years in 2012. This drought was attributed to reduced rains due to ElNiño. However, it appears from some of the recent studies that this relationship has been weakening in recent years, possibly due to global warming.

Photo 3: Flood in River Bagmati in Nepal

Photo Credit: Nabin Baral, ICIMOD

As global temperature increases, fresh water stored as ice in glaciers, ice caps and at the poles is expected to melt, causing sea levels to rise. Ocean thermal expansion is another chief factor of sea level rise in current times. Those levels will vary from place to place due to various factors like ocean currents, difference in sea water temperature and salinity. The Intergovernmental Panel on Climate Change (IPCC) estimates that under all its scenarios, the sea level will continue to rise in the 21st century (IPCC 2014). This would cause an additional 80 million coastal residents in Asia alone to be flooded. The majority of those flooded will be in South Asia, particularly in Bangladesh and India. In Maldives, a long-term trend of an increase of 1.7 mm/year has been observed. Also, forecasts predict an increase in

3 EM-DAT classifies an event as disaster when the following criteria has been fulfilled: 10 or more people are killed; 100 people reported affected; a call for international assistance and declaration of a state of emergency

the frequency of events such as an hourly sea level rise of 70 cm above mean sea level in the future (Ministry of Environment, Energy and Water 2007).

1.3 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 the 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.

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. Of the countries in South Asia, two are predominantly Hindu, namely, India and Nepal; four are predominantly Muslim, namely, Afghanistan, Bangladesh, Maldives and Pakistan; two are predominantly Buddhist, namely, Bhutan (Mahayana Buddhism) and Sri Lanka (Theravada Buddhism). Bangladesh is racially and linguistically homogeneous, where Bengali is the dominant language (99 percent). In Bhutan, the majority (approximately 70 percent) of the population is Mongoloid or Indo-Mongoloid. India's population is divided by the 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) indigenous population. Language divides the Indian population into many large and small territorially concentrated minorities. Hindi (30 percent) is designated the official language, though it is the dominant language only in some northern Indian states.

The region's rich heritage embraces some of the most sought after philosophies and ways of life, as well. Vaastu Shastra[4] and the Atharva Veda[5], 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.

Socio-economic factors like hunger, poverty, unemployment and trauma have created inhuman conditions, and given rise to the need to break the shackles of extreme want, through extreme actions. Creating cultural liberty is also a challenge for this region. It is a vital part of human development. It gives the people the freedom to practice their religion openly, to speak their language, to celebrate their ethnic and religious heritage without the fear of ridicule or punishment. In this multi-cultural region, the quality of life should be defined in more holistic terms rather than purely economical ones, like the GDP. Gross National Happiness (GNH) is one such attempt developed by Bhutan. 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.

Photo 4: Stupas at Docula Pass Exemplifying the Rich Cultural Heritage of Bhutan

Photo Credit: Tshering Tashi

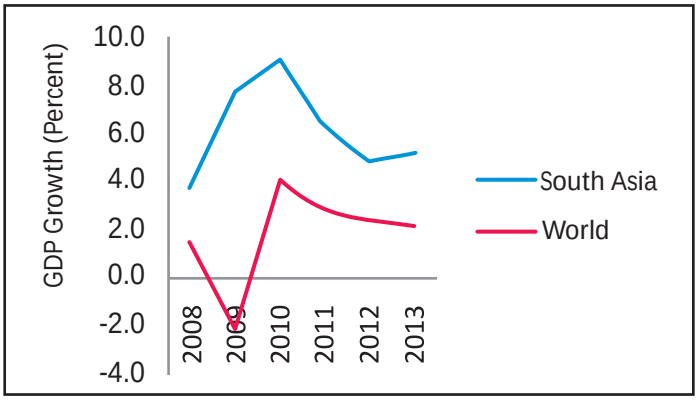
4 Vaastu Shashtra is an ancient doctrine which consists of commandments born out of traditional views on how laws of nature affect human dwellings.

5 Atharva Veda is a sacred text of Hinduism and is one of the four Vedas.

1.4 The Economic Base

South Asia is a key economic zone in the global arena. This can be attributed to two main factors. Firstly, South Asia is a lucrative market for a different range of products due to its constantly growing population. Secondly, the countries of this region, with the exception of Maldives and possibly Sri Lanka, are all major debtor countries with low levels of per capita income. These countries are unable to break free from the 'low-level equilibrium trap'-created by low rates of capital formation-that compounds the need to build up a capital base (UNEP and DA 2009).

Figure 1: GDP Growth in South Asia as Compared to the World

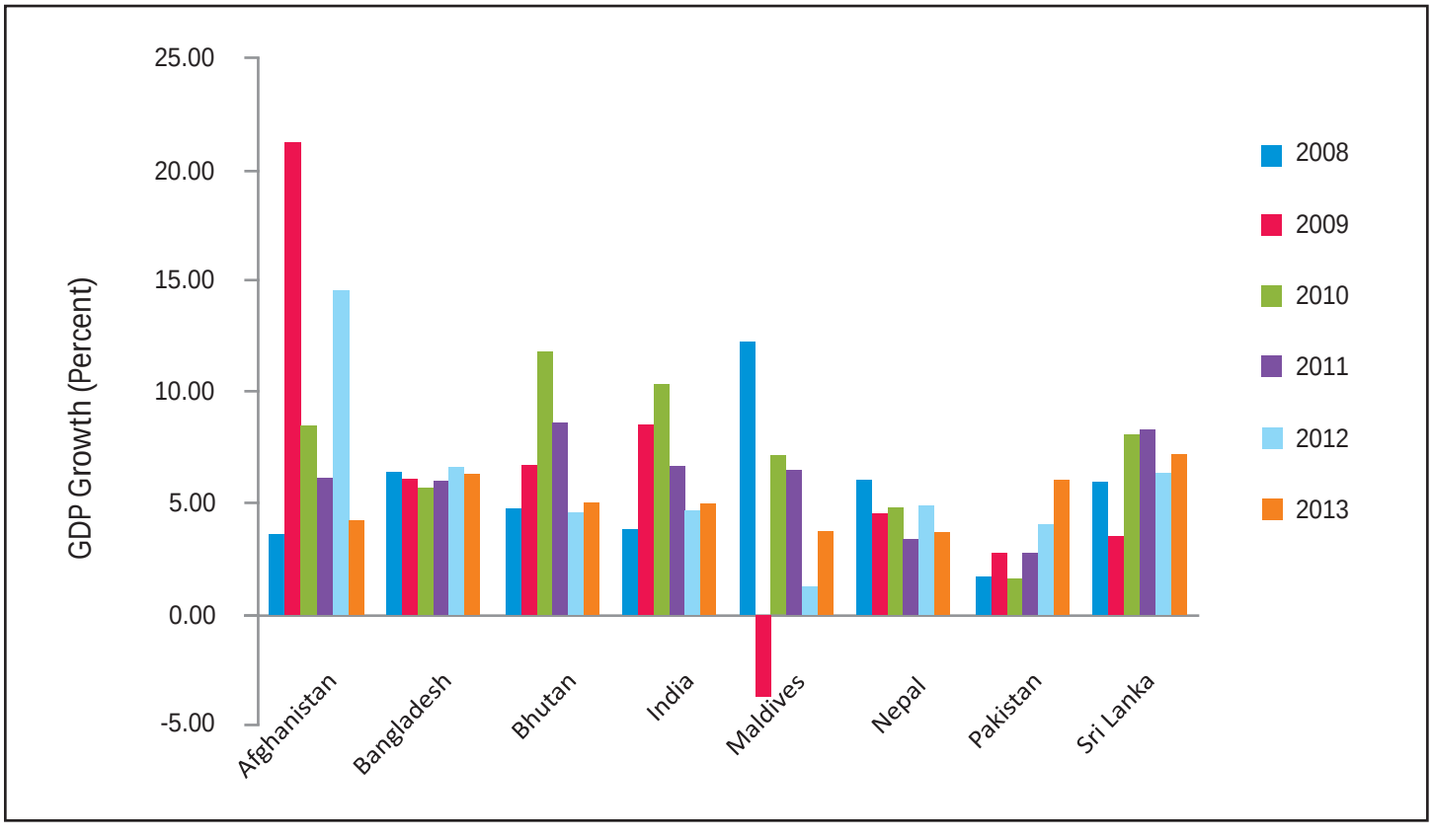


Source: World Bank (2012b)

South Asia has been one of the fastest growing regions in the world in the past few years.

Figure 1 exemplifies the economic malaise being faced by the world after the global economic crisis of 2008. South Asia also suffered heavily due to this crisis. However, the impacts of the crisis were observed to be less severe in the region due to various policy reforms that resulted in rapid growth, especially in India. A robust recovery was observed in 2009, with a GDP growth rate of 7.77 percent after a dip in the growth rates in 2008. However, the economic activity has slowed down in 2011 to an average rate of 6.3 percent and 4.9 percent in 2012 (World Bank 2013b). This slow-down can be attributed to a pronounced reduction in the industrial production and restrictive macro-economic policy stances aimed at reducing inflation and unsustainably large fiscal deficits. According to the World Bank, higher borrowing costs, elevated inflation and some local factors like policy uncertainty, stalled reforms, and deteriorating political and security conditions contributed to the decrease in investment growth. However, a slight increase in GDP was observed in 2013.

Figure 2: GDP Growth Rate of South Asian Countries



Source: World Bank, (2013b)

The economy of Afghanistan experienced a high growth rate in recent years, as illustrated, by a 21.02 percent growth in 2009. Strong investment in the construction sector, especially due to donor-led investment projects, has enhanced the economy. However, its heavy dependence on foreign aid is a cause for concern. The GDP growth rate of Bangladesh averaged approximately six percent throughout the economic crisis. The economy of Bhutan hinges on renewable natural resources, hydropower, tourism and industry. The Indian economy has slowed down since 2010. This can be partially attributed to the global economic slow-down and monetary tightening of policy rates by the Reserve Bank of India (RBI) to curb inflation.

Tourism, fisheries, construction and commerce play a significant role in the economy of Maldives, which staged an impressive recovery after 2009. The economy of Nepal has been growing at a slower rate as compared to the rest of the region. The growth rate of Pakistan slowed down to 2.96 percent in 2011. According to United Nations Economic and Social Commission for Asia and Pacific (UNESCAP), the slow-down can be attributed to prevailing security concerns, shocks from elevated oil prices, floods in the country and severe shortages of electricity and natural gas (UNESCAP 2012). A slight recovery was seen in 2012 with a growth rate of 4.19 percent. The economy of Sri Lanka grew at a rate of around eight percent in 2010 and 2011. However, a decrease in the GDP growth rate was observed in 2012. The service sector, industrial sector and agricultural sector are the major contributors to the economy.

Apart from the loss of human life, climate disasters also destroy property and infrastructure, affecting the economies. They diminish the productive capacity of a country and result in inflationary pressures. The effect of natural disasters on the economy can be explained by the example of Pakistan. Severe flooding in Pakistan in 2010 and 2011 resulted in a dampening effect on the economy. The GDP growth rate reduced from 3.60 percent in 2009 to 2.96 percent in 2011 (World Bank 2013b).

South Asia is the least integrated of all the global regions, and barriers to trade, investment, and movement of people are very high. Regional cooperation can be a powerful tool for increasing growth, reducing the gap between leading and lagging regions, and reducing the vulnerability of the poor. By focusing on the income of the poor, both through the growth mechanism and by reducing vulnerability, regional cooperation can be helpful in lowering income inequality.

1.5 Governance in the Region

The political culture of South Asia is a composite result of several important influences. Given the layering of diverse cultures and geographies, it is characterized by a myriad maze of different expressions. This is seen in the various forms of government that have been produced by the political systems: democratic, socialist, military and monarchical. Military rule, monarchy and centralized autocratic political systems are accepted within the framework of democracy in the region (Nepali 2009).

Despite the variations in the forms of government, the countries of South Asia are quite similar in terms of the objectives, structures, functions, attitudes, and standards of governing bodies. This can be attributed to the fact that the modern system of government and administration in South Asia by and large evolved under the British colonial rule, except Afghanistan, Bhutan and Nepal. In the last 10 to 15 years, there has been a reinforced trend for more decentralized political and administrative structures in South Asia. It is perhaps one of the most important governance and institutional reform initiatives towards reducing poverty. Decentralization involves the transfer of responsibilities and powers from the central government to intermediate and local governments, which can provide public services more efficiently. It enables the establishment of mechanisms by which citizens can hold different tiers of government accountable. Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka, have adopted changes in their constitutions and legal frameworks to re-define the roles, functions and functionaries of local governments (World Bank 2013d).

With all the similarities and differences, South Asian countries fall among the lowest group of countries in terms of human development and quality of governance. A paradox in South Asia is the participation of women in Governance. There has been predominance of women leaders at the highest level; it has more powerful women politicians than any other set of countries in the world. Yet, overall women's participation is dismal. The membership of women in the parliaments of these countries has ranged between six and eight percent during the last few decades. The countries of South Asia have taken steps to remedy this situation, mainly through reservations (quotas in electoral bodies) (Omvedt 2005).

Environmental governance at the global, regional and national level is critical for achievement of environmental sustainability. With growing awareness on environmental issues, attempts have been made by the South Asian countries to integrate the objectives of sustainability in the governance process, as reflected in their development strategies/ visions. Such attempts include bilateral and multi-lateral agreements at the global level and promotion of decentralized conservation efforts and development projects at the local level.

Bhutan, India, Nepal and Pakistan, (among others) have integrated sustainable development in their planning process. The 12th Five Year Plan (2012-2017) of India, aptly named '*Faster, More Inclusive and Sustainable Growth'*, states that the development process can not afford to ignore the environmental consequences of economic activity, or allow depletion and deterioration of natural resources. The Framework for Economic Growth of Pakistan includes action matrices comprising timelines of implementation of objectives and identifying federal and provincial ministries/departments/statutory bodies assigned to guide and oversee the implementation process. It also includes a matrix on environment and climate change sector.

Countries have also adopted a fairly comprehensive set of policies and laws that cover a wide range of environmental issues. For example, the key environment related policies of Nepal are the National Conservation Strategy (1988), Nepal Environment Policy and Action Plan (1993), Solid Waste Management Policy (1996), Nepal Biodiversity Conservation Strategy (2002) and National Wetland Policy (2003). India also has enacted several environmental laws, such as the Wildlife Protection Act (1972) and the Water (Prevention and Control of Pollution) Act (1974). In Pakistan, laws and policies like Pakistan Environment Protection Act (1997), National Environment Policy (2005), National Sanitation Policy (2006) and the National Climate Change Policy (2012) exist to address the environmental and climate change issues.

Some of these laws empower or define the role and authority of relevant institutions to facilitate coordinated decision-making. In Sri Lanka, the National Environment Act, (1980) established the Central Environment Authority as the premier State institution for the protection and management of the environment. The Environment Protection Act (1997) of Nepal provides legal validity to the existing Environment Protection Council. However, it should be kept in mind that proper implementation of such policies is critical for mainstreaming environmental issues in the development process.

Box 1: Gross National Happiness (GNH)

Bhutan's emphasis on environmental sustainability is illustrated by its development philosophy 'Gross National Happiness'. It is an attempt to define quality of life in more holistic and psychological terms than the Gross National Product. The concept of GNH is based on the premise that true development of human society takes place when material, spiritual and emotional well-being occur side by side to complement and reinforce each other. Environmental sustainability is an integral part of the philosophy. It should be ensured that the development pursuits are within the limits of environmental sustainability and are carried out without impairing the biological productivity and diversity of the natural environment. Other pillars include good governance, sustainable socio-economic development and cultural preservation.

Source: National Environment Commission (2008)

1.6 Environmental Priorities in the Region

South Asia faces several environmental issues. Due to the likeness in their social, cultural and economic situation, similar challenges are faced by the countries. The region is plagued by environmental threats such as climate change, land degradation and deforestation, air and water pollution, and loss of biodiversity. Poverty and human development are also linked to the environmental priorities of the region.

The environmental concerns are reflected by environmental indicators. The indicators can be sub-divided in to the following categories: 1. Social, 2. Economy, and 3. Environment. The category 'Environment' is further sub-divided into 1. Land, 2. Water, 3. Air, and 4. Biodiversity. These indicators give a comprehensive snapshot of the regional progress on environment and sustainable development. These environmental threats arise from major drivers of change like population growth and urbanization, economic growth, unsustainable patterns of consumption and climate change. These drivers influence major sectors like energy, industry, waste, forestry and land use. They degrade the environment through uncontrolled urbanization and industrialization, expansion and

intensification of agriculture and destruction of natural habitats.

The table below summarizes the key environmental issues in the region.

Table 3: Environmental Issues in South Asia

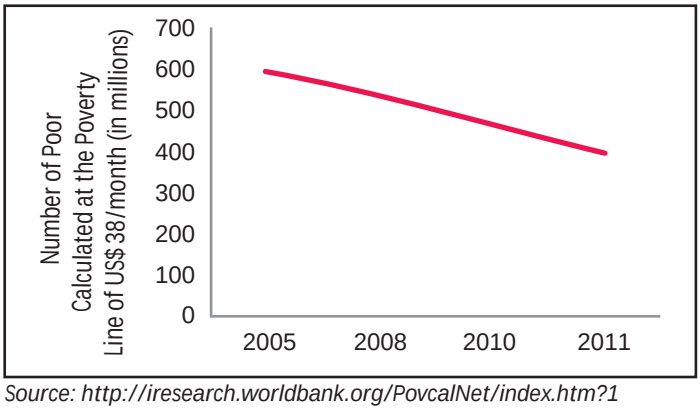
Country	Key Environmental Issues
Afghanistan	Deforestation; soil erosion; desertification; urban air pollution; access to water and sanitation; deteriorated water quality; loss of biodiversity
Bangladesh	Air quality deterioration; localized water shortages; land degradation and soil erosion; forest and agricultural land conversion; solid waste generation and disposal; localized water pollution in urban areas; climate change; glacial melt
Bhutan	Air quality deterioration; localized water shortages; land degradation and soil erosion; land (forest and agricultural) conversion solid waste generation and disposal; localized water pollution in urban areas; climate change; glacial melt
India	Deforestation and land degradation; desertification; soil erosion; forest and agricultural land covers conversion; urban air pollution; water pollution; arsenic contamination in some groundwater segments; loss of biodiversity; climate change and sea-level rise; glacial melt
Maldives	Air pollution; water (ground and marine) pollution; waste generation; sea-level rise; coral reef bleaching
Nepal	Forest depletion and land degradation; air pollution; waste generation; climate change
Pakistan	Deforestation; desertification; water pollution; loss of biodiversity; climate change; air pollution
Sri Lanka	Land degradation; deforestation; waste generation; air pollution; loss of biodiversity; climate change

Source: Compiled from Various Sources

1.7 Human Development

Economic and social development have positive and negative impacts on the environment, including conservation and protection of natural resources. In fact, poverty and human development are inextricably linked to environmental issues. As mentioned earlier, the population living below the poverty line was 5398.95 million in 2011[6]. A significant improvement can be seen in the population subsisting below the poverty line over five years. The reduction in poverty levels can be attributed to the robust economic growth in the region.

Figure 3: Trends in Poverty in South Asia



Source: http://iresearch.worldbank.org/PovcalNet/index.htm?1

A more comprehensive indicator to measure social and economic development is the Human Development Index[7]. In 2012, South Asia had one of the lowest HDI values, i.e. 0.558, higher only than Sub-Saharan Africa However, the region has witnessed continued progress from previous decades. The life expectancy of South Asia in 2012 was 66.2 years. Mean years of schooling was 4.7 years as compared to the expected years of 10.2 years. The income per capita increased during the time period from 1990 to 2012. Another indicators of human health are satisfaction with the quality of health care and education. According to a survey conducted by UNDP, 65 percent of the respondents in South Asia indicated satisfaction with the health care quality, with Pakistan at 41 percent and Sri Lanka at 83 percent . Despite continued progress in HDI from previous decades, high gender disparities persist in the region, which is illustrated by low female representation in parliament, gender imbalances in educational achievement and low labour force participation (UNDP 2013).

6 http://iresearch.worldbank.org/PovcalNet/index.htm?1

7 It combines the indicators of life expectancy, educational attainment and income into a single reference frame for social and economic development.

Table 4: HDI Ranks of Countries in South Asia

Country	HDI Rank in 2012	Change in HDI from 2007-2012
Afghanistan	175	0
Bangladesh	146	1
Bhutan	140	--
India	136	-1
Maldives	104	1
Nepal	157	2
Pakistan	146	-1
Sri Lanka	92	5

Source: UNDP (2013)

1.8 Regional Cooperation Initiatives

In the context of regional cooperation on environmental issues, the efforts of two inter-governmental organizations are notable. These are (i) South Asian Association for Regional Cooperation (SAARC) and (ii) South Asian Cooperative Environment Programme (SACEP).

SAARC

With its headquarters in Kathmandu, SAARC provides a platform for the governments and people of South Asia to work together "in a spirit of friendship, trust and understanding". Apart from its focus on economic cooperation, it also covers many other aspects of regional cooperation including environment.

Since its formation, SAARC has adopted eight agreements. In 1997, SAARC environment ministers agreed to an Environment Action Plan that sets out various parameters for regional cooperation. 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, and control of (as well as preparedness to deal with) natural calamities".

Two major declarations that focused on climate change include the SAARC Dhaka Ministerial Declaration on climate change, along with the SAARC Action Plan on Climate Change in 2008 and the Thimpu Statement on Climate Change in 2010. In pursuance of the 1997 and 2008 action plans, a number of SAARC centres have been established, including the SAARC Forestry Centre in Thimpu, the SAARC Disaster Management Centre in New Delhi, the SAARC Meteorological Centre in Dhaka, and the SAARC Coastal Management Centre in Maldives.

SACEP

Recognizing the need for regional cooperation in sharing and management of natural resources and to support the protection, management and enhancement of the environment in the region, SACEP was established in 1982 by the Ministers of Environment of SAARC member countries. Its objectives include promotion of mutually beneficial cooperation in priority areas of environment; promotion of exchange of knowledge and expertise; and formulation, financing and implementation of environmental projects. Its secretariat is located at Colombo. SACEP has implemented a number of projects and programmes in the areas of environment education, environment legislation, biodiversity, air pollution, and the protection and management of the coastal environment. It is also responsible for the implementation of major regional programmes like the South Asian Seas Programme, South Asia Biodiversity Clearing House Mechanism, South Asian Coral Reef Task Force, South Asia Network for Security and Climate Change and International Partnership for Expanding Waste Management Services of Local Authorities.

South Asian Seas Programme

Established in 1982, the South Asian Seas Programme (SAS) is one of the 17 programmes of Regional Seas Programme of UNEP. It focuses on integrated coastal zone management, oil-spill contingency planning, human resource development and pollution of marine resources caused by land-based activities.

Over the years, SACEP and its member countries have been actively involved in conducting various activities related to their focus areas. In order to enhance the cooperation between countries in the event of an oil or chemical spill, a Regional Oil and Chemical Pollution Spill Contingency Plan was developed. After various consultations, all the countries have endorsed the plan. A regional and National Plan of Actions for Global Programme of Action (GPA) has been formulated by the countries. GPA intends to minimize land based pollution. Many training and awareness generation programmes have been conducted on management of protected areas and coral island

ecosystems, integrated coastal and river basin management, marine litter, invasive alien species, disaster management and various others. One of the major achievements of this programme has been the setting up of the Coral Reef Task Force.

South Asia Coral Reef Task Force

The South Asia Coral Reef Task Force (SACRTF) was established to facilitate the implementation of regional and international initiatives in the management of coral reefs and associated ecosystems, and to promote collaborative action, and trans-boundary responses to shared environmental challenges. It was endorsed by the country governments of the five maritime nations of South Asia, at the SACEP Governing Council Meeting in Nepal, in January 2007.

Another significant effort of SACEP is the Male Declaration on the Control and Prevention of Air Pollution and its likely Trans-boundary Effects for South Asia.

Table 5: Other Networks and Institutions for Regional Cooperation

Institution	Roles and Responsibilities
Regional Integrated Multi-Hazard Early Warning System	Regional Integrated Multi-Hazard Early Warning System was set up using UNESCAP Trust Fund that provides early warning products/ services for tsunami, cyclone, floods, droughts and storm surges covering South Asia. Its secretariat is located in Maldives.
International Centre for Integrated Mountain Development (ICIMOD)	Based in Kathmandu, ICIMOD is a regional intergovernmental learning and knowledge sharing centre serving the eight countries of the Hindu Kush Himalayan region- Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. ICIMOD aims to increase the awareness of mountain people about the impacts of climate change and assist in their adaptation. They support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. Also, they strengthen networking among regional and global centres of excellence.
South Asia Youth Environment Network (SAYEN)	The South Asia Youth Environment Network brings together youth with a vision of promoting sustainable development in South Asia. Set up in July 2002, SAYEN is linked to TUNZA, UNEP's strategy for engaging young people in environmental activities and in the work of UNEP. Centre for Environment Education (CEE), India, hosts the Secretariat for SAYEN, which has membership from all the eight SAARC countries. SAYEN has a membership from over 5000 individuals and organizations. UNEP's Regional, sub-regional and National Youth Advisors support the SAYEN secretariat at CEE in planning and implementing activities in the region. This gives youth the opportunity to hone their leadership skills and for SAYEN, the rich pool of young creative individuals. The key activities of SAYEN include Networking and Information Servicing, Capacity Building, Documentation, Developing resource materials and Creating Awareness Programmes for youth. SAYEN organizes capacity building programmes to help youth to understand sustainable development issues, challenges and efforts through participating in ongoing projects and initiatives.
Climate Action Network South Asia (CANSA)	CANSA has been on the driving seat to pursue "climate change and development" issues both internally within the region and outside the region. It is a credible forum for South Asian civil societies to come together and speak out on climate change issues. With organizational member of 60 NGOs in six countries of South Asia, one of the major strategies of CANSA has been to outreach civil societies in all South Asian countries. This process has been guided by two broad objectives: establishing a strong voice of South Asia in negotiations and contributing to CAN international policy advocacy and lobby work; secondly, targeting SAARC towards a regional cooperation at least from Climate Change perspectives.

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Drivers of Environmental Change

Chapter 2

Photo Credit: GEO - 5

A driver is any natural or human-induced factor that directly or indirectly causes a change in an ecosystem. Understanding the growth of these drivers and the correlation between them would be useful to understand the impacts and find possible solutions. This section highlights major drivers of environmental change in South Asia: population growth and urbanization, economic development and climate change.

Our Planet Earth's biosphere is a complex and dynamic system, comprising both living organisms and inorganic materials. It is a self-regulating environment which regulates the physical conditions to keep the environment hospitable for different life forms (Lovelock 1972). Human beings are dependent on the environment for their development. Human activities contribute to environmental changes through transformation and transportation of large quantities of energy into products and services to meet the human needs and aspirations. In present times, these activities are disrupting the biological, physical and chemical processes of the earth's systems. Examples of such impacts include alterations in the carbon cycle by releasing large quantities of carbon dioxide (CO_2) into the atmosphere due to fossil fuel combustion; increase in emissions of metals such as lead, cadmium, zinc, mercury etc. (Nriagu and Pacyna 1988); disruption of nitrogen, phosphorous and sulphur cycles; destruction of ecosystems that has led to biodiversity loss; and, changes in land cover like diminishing forests and desertification (Rockstrom *et al.* 2009). Left unmanaged, anthropogenic activities would cause further degradation of the environment.

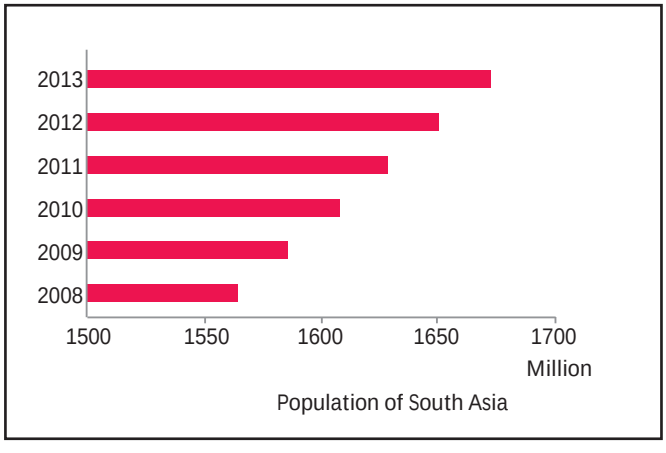
According to the Millennium Ecosystem Assessment, a driver is any natural or human-induced factor that directly or indirectly causes a change in an ecosystem. Understanding these drivers is the key to addressing the environmental change impacts and mitigating them. As a matter of fact, drivers influence key sectors like energy, industries, land-use change, forestry and waste sectors.

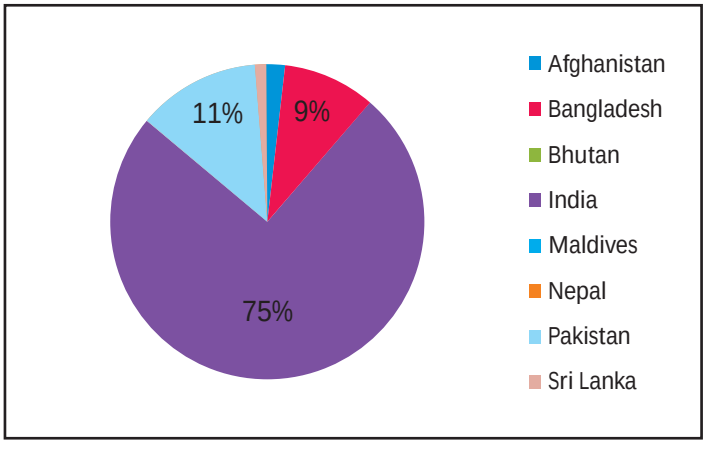
Population growth and economic development are the key drivers of change in the South Asian region. They degrade the environment through uncontrolled urbanization and industrialization, expansion and intensification of agriculture and destruction of natural habitats. Understanding the growth of these drivers and the correlation between them is necessary useful to understand the impacts and find possible solutions.

2.1 Population Growth

The global population has doubled since the 1950s, reaching seven billion in 2012 (World Bank 2012a). According to UN Statistics Division, Asia and Oceania have the largest population (UNDESA 2011). Though South Asia occupies only 4.8 percent of the world's land mass, it is home to about 20 percent of the world's population. Currently, it has a diverse population of about 1.67 billion. India is the most populated country in the region, followed by Pakistan. Countries like Bhutan and Maldives are comparatively less populated than other countries in the region. The population of Bhutan was 753,947 as compared to 1.25 billion of India in 2013. The population of Maldives was 345,023 in 2013 (World Bank 2013a). According to UN projections, the population of South Asia will cross the two billion mark in 2100. By 2028, the population of India is projected to surpass even that of China (UNDESA 2013).

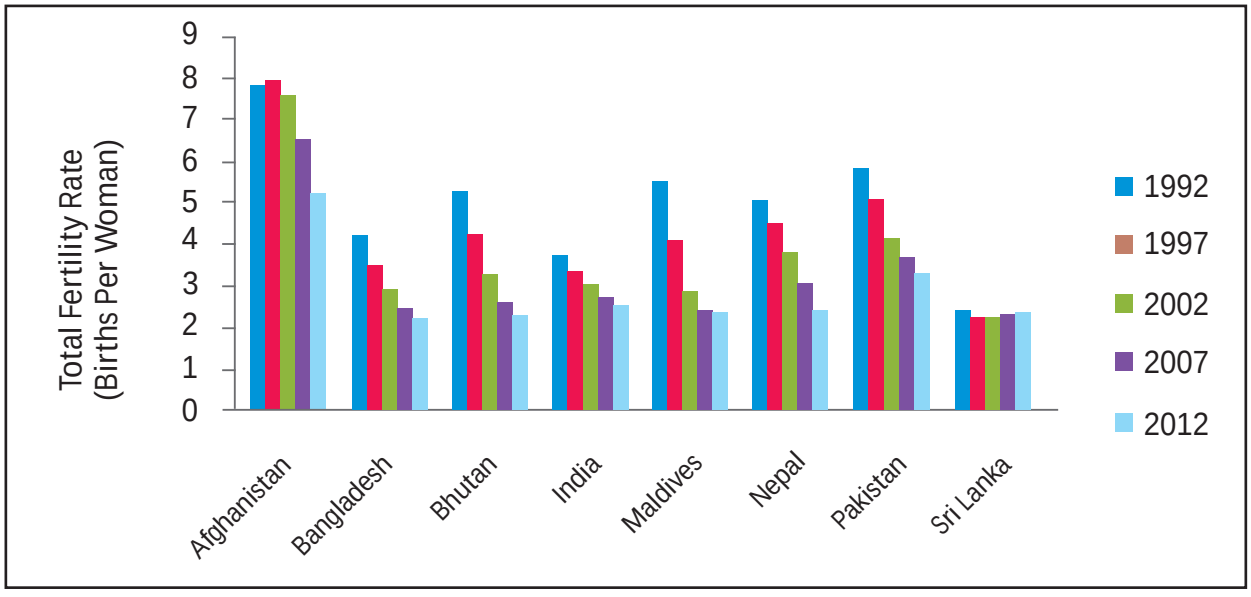
Figure 4: Trends in Population of South Asia (Left) and Total Population of South Asian Countries (Right)





Source: World Bank (2013a)

Figure 5: Fertility Rate in South Asia



Source: World Bank (2012b)

The current population boom can be attributed to the population momentum stemming from past population increases. Fertility rates were quite high in the rural areas of less developed countries (Bongaarts and Bulatao 1999). Higher fertility rates in previous decades have culminated in a generation of a huge number of youth, now entering (or belonging to) the reproductive age group. This has led to a large number of births overall, even though the fertility rates are on the decline. Globally, the fertility rate has decreased from 4.98 in 1960 to 2.47 in 2012. In South Asia, the fertility rate was 2.59 in 2012. However, the fertility rate varied broadly in the region. Maldives has the lowest fertility rate of 2.29. Afghanistan has the highest rate of 5.14, whereas the fertility rate of India is 2.51 (World Bank 2012b).

Lower fertility rates in recent times can be attributed to the launch of family planning programmes in the South Asian countries, with the support from international organizations. In 1952, the Government of India was one of the first in the world to launch a family planning programme. In the Eighth Five Year Plan (1992-97), the government identified human development as its main focus, with health and population stabilization listed as two of the six priority objectives. A family planning programme in Pakistan was launched in 1965. After its birth in 1971, Bangladesh reorganized its family planning programme under the Ministry of Health and Family Planning. Similar programmes were also launched in Nepal and Sri Lanka. Apart from the government programmes, several initiatives implemented in small pockets of the region have been successful in increasing the contraceptive use and reducing the fertility. Matlab Project, Bangladesh is one such well-known initiative in the region. However, family planning is not the sole reason for fertility decline and the fertility rate falls with the rise in income (Prichett 1994).

Box 2: Matlab Project, Bangladesh

In collaboration with the Ministry of Health and Population Control, International Centre for Diarrhoeal Disease Research (ICDDR, B), Bangladesh initiated a Contraceptive Distribution Programme in 1975 in 150 villages through 154 Lady Village Workers. The contraceptive use rose from one percent to 18 percent after three months. However, it fell to 12 percent at the end of the second year due to high discontinuation rates and poor recruitment of new users.

An improvement from the previous programme, Matlab contraceptive distribution programme of 1977 was introduced to 70 villages, with a total population of 80,000. Female Village Health Workers counselled clients on family planning and provided condoms, oral contraceptives, and vaginal foaming tablets. The yearly mean contraceptive rate for modern methods rose from 9 percent in 1977 to 32.4 percent in 1974 and reached 45.6 percent in 1985. The success of the project is reflected in the rise in contraceptive prevalence and reduced child mortality in the area. Based on the success of the Matlab Project, similar programmes were initiated in 1984 in the sub-districts of Airaiganj.

Source: Nag (1992)

Similar to the fertility rate, the region has also witnessed a transition from high to low mortality rates. Crude death rates (deaths per 1,000) decreased from 10.46 in 1991 to 7.80 in 2011. The life expectancy of this region increased from 59.26 in 1991 to 66.64 in 2012 (World Bank 2012c).

Migration is another component of demographic transition. South Asia is predominantly characterized by rural to urban migration, along with international migration. Rural to rural migration has been on decline in the region. On the other hand, rural to urban migration has been continually on the rise. Rural to urban migration is a response to varied economic opportunities in cities. A difference in income is a major factor in migration to cities. Another migration pattern is that of international migration. Worker migration from South Asia has been on the rise. The total number of worker migration from Bangladesh, India, Nepal and Sri Lanka reached over two million. However, the number of outgoing workers was affected by the global financial crisis of 2008 (Ozaki 2012).

Population Impact

The impact of human society on environment is a function of three major, inter-connected elements: population size, affluence or consumption, and technology, according to Ehrlich and Holdren (1971). They devised the IPAT equation which took into account the three above-mentioned factors to estimate the impact on environment. Thus, impact (I) was expressed as the product of population (P), affluence (A), and technology (T).

$$IPAT\ [I = P * A * T]$$

Loss of Natural Resources

Human population is growing beyond the carrying capacity of our planet, impacting the environment negatively. Population growth and demographic transitions are directly related to land degradation, resource depletion, food security, air quality degradation, and loss of biodiversity. As the population increases exponentially, the demand for goods and services (such as food, shelter, energy) also increases, leading to unsustainable consumption of natural resources. Hence, natural resources are under extreme pressure due to burgeoning human population and urbanization.

Endangered Biodiversity

South Asia harbours a diverse range of ecosystems, having a rich variety of floral and faunal species. However, the number of species endangered by human activities is increasing in recent times. The reasons for biodiversity loss can be attributed to human induced elements like habitat fragmentation, introduction of exotic species. homogenisation of species in agriculture and poaching. Habitat loss poses the greatest threat to biodiversity. Deforestation is the main reason for habitat fragmentation. South Asia shares approximately 19 percent of the Asia-Pacific region's total forest cover, providing cross-border habitats for a wealth of species. This region has been severely hit by deforestation in the recent past. It has occurred mostly due to the expansion of agricultural land, intensive harvesting of wood, timber for fuel and other forest produce as well as overgrazing.

Reducing Water Security

The impact of population growth on water availability and water-quality can also be clearly observed. Though South Asian countries are home to about one-fourth of the world's population, they contain merely 4.5 percent (1,945 billion m^3) of the world's renewable water resources (43,659 billion m^3) (UNEP and AIT 2008). Except for Bhutan and Nepal, the per capita availability of water in the region is less than the world average. Population growth, along with higher consumption lifestyles, is putting tremendous pressure on the water resources. Global water withdrawals have increased in recent times in response to the growing world population. While water supply has remained relatively constant, demand now exceeds the sustainable supply in many places, with serious long-term implications. It is mainly used in agriculture in this region. As the demand for food increases, the demand for irrigation water will also follow suit. Reduced access to water for use will have cascading effects including reduced food production, loss of livelihood security and large-scale migration within and across borders.

Water availability is also on the decline due to water-fertilizer intensive agriculture, over-exploitation of groundwater for drinking, industrial and agricultural purposes, and large scale contamination of water resources by industrial and domestic effluents. These water-related problems are further compounded by climate change. There have been incidences of policy interventions, creating water stress in the region. Subsidized electricity has motivated farmers to extract groundwater for irrigation purposes in Bangladesh, India and Pakistan. However, few states in India like West Bengal are metering the agricultural tube wells to facilitate the efficient use of groundwater. The subsidies promoting extraction of groundwater have reduced substantially in Pakistan as well.

Photo 5: Water Scarcity is Forcing People to Walk Quite a Distance to Collect Water

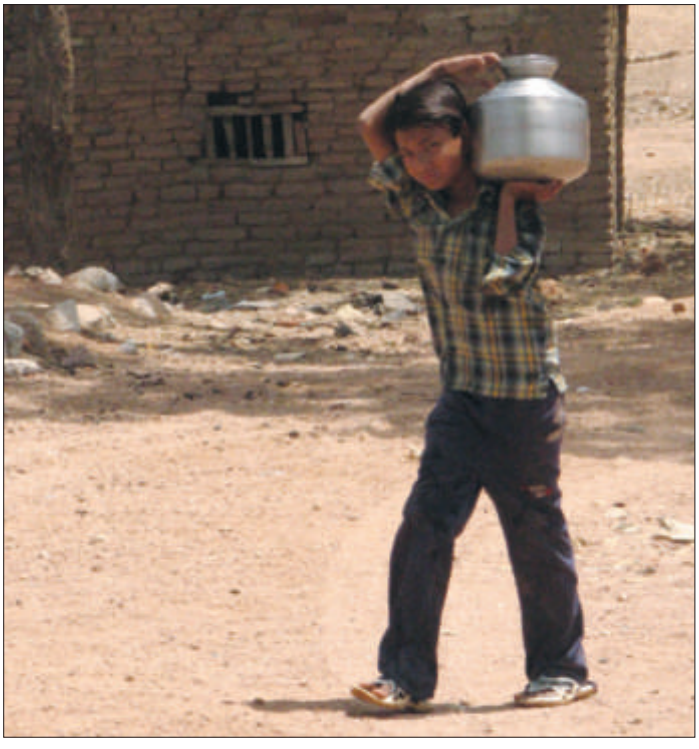


Photo Credit: Development Alternatives

Freshwater is being polluted by industrial effluents, domestic waste water and land-use run-offs. Leaching from mine tailings and solid waste dumps are also major culprits of water pollution for freshwater and groundwater sources. Agriculture also plays a major role in deteriorating water quality. Run-off from agricultural lands causes water pollution due to the increased use of fertilizers and pesticides. Dams are also a part of the water-population equation. Although beneficial in terms of increased agricultural productivity and energy issues, dams affect fisheries and aquatic ecosystems negatively. Disruptions in natural flood cycles can disproportionately affect the rural poor, whose livelihoods often depend on wetlands, fisheries, and flood-dependent agriculture. The impact of population growth on water quality can be explained by the arsenic contamination in groundwater in the Ganga-Brahmaputra fluvial plains in India, Padma-Meghna fluvial plains in Bangladesh and north-central Sri Lanka. West Bengal, Bihar, Jharkhand, Uttar Pradesh, Chhattisgarh, Assam and Manipur in India are severely affected by arsenic contamination. It is believed that arsenic is released in the groundwater by natural means. However, excessive extraction of groundwater for irrigation may be the main reason for arsenic entering the food chain (FAO 2006).

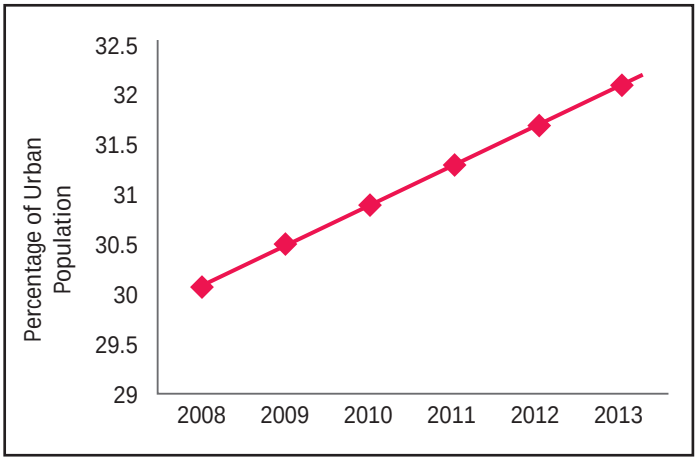
Land Degradation

Humans depend on ecosystem goods and services of land for their survival. However, the region is plagued by land degradation. Land is under immense pressure as agriculture, urban land and forest areas all compete for the same resource. As mentioned earlier, food production has increased to fulfil the demand of the growing population. Modern agriculture has successfully increased the food production. However, excessive use of machinery and chemical supplements like chemical fertilizers and pesticides for agriculture increase soil-erosion, pollute the soil, contaminate the groundwater and surface water, change greenhouse gas fluxes, destroy habitat and build genetic resistance to chemical supplements (Blanco-Canqui and Lal 2010, Foley *et al*. 2005). Soil erosion is a distinct symptom of land degradation. Erosion in conventional agricultural systems is now three times higher than in systems practicing conservation agriculture, and over 75 times higher than in systems with natural vegetation (Montgomery 2007). South Asia also faces degradation by water as many areas have high rainfall and steep mountainous region. Also, rampant water withdrawals, coupled with deforestation, have allowed the wind to scour out arable soils, making vast expanses of the landscape vulnerable to desertification. Afghanistan, for example, is highly vulnerable to desertification. The consequences of land degradation include reduced productivity of land, food insecurity and loss of biodiversity. Food security is yet another daunting challenge. In fact, exponential growth of population will lead to an increased demand for food, which is bound to exert additional pressure on sustainable food production.

2.2 Burgeoning Urbanization

South Asia is in the midst of a rapid transformation from a predominantly rural to urban society. The region has seen an upward trend in urban population with an annual growth rate of 2.60 percent (World Bank 2013b). Delhi, Mumbai, Kolkata, Dhaka and Karachi were among the largest agglomerates in the world in 2011. It has been estimated that by the middle of the 21st century, at least 50 percent of the population will be residing in urban areas (UNDESA 2011). Urbanization will not be limited to only large cities. Much of the urbanization will occur in small towns and cities of the region.

Figure 6: Percentage of Urban Population in South Asia



Source: World Bank (2013b)

Table 6: Urban Agglomerations in South Asia with 10 million Inhabitants or More

1990	2014	2030
Mumbai, India Kolkata, India	Dhaka, Bangladesh Delhi, India Mumbai, India Kolkata, India	Dhaka, Bangladesh Delhi, India Mumbai, India Kolkata, India Bengaluru, India Chennai, India Hyderabad, India Karachi, Pakistan Lahore, Pakistan

Source: UNDESA (2014)

Deteriorating Air Quality

Urbanization is a major driver of environmental change. The rapid expansion of urban populations is placing enormous pressure on urban services. Rural to urban migration and associated livelihood changes are often accompanied with changing patterns of energy use and increased meat and dairy consumption, which can intensify land pressures on productive rural areas. Urbanization and industrialization generate air pollutants like sulphur oxides (SO_x), nitrogen oxides (NO_x) and particulate matter. Cities like Dhaka, Karachi, Lahore and major cities in India suffer from deteriorating air quality. Increasing amounts of soot, sulphates and other aerosols such as black carbon contribute to the formation of Atmospheric Black Clouds (ABCs). The Indo-Gangetic plain has been identified as one of the five regional ABC hotspots around the world (Ramanathan *et al.* 2008). ABCs significantly affect the regional climate, hydrological cycle and glacial melting due to soot deposition on the Hindu Kush-Himalayan-Tibetan (HKHT) glaciers and snow peaks. The decrease in Indian monsoon rainfall due to ABCs is also a major cause for concern. Such an impact on the water resources poses a grave threat to the water and food security of the region. In addition, urban areas are also major emitters of greenhouse gases (GHG), further adding to the threat of climate change.

Photo 6: Urbanization in Afghanistan

Photo Credit: NEPA, Afghanistan

Apart from air pollution, solid waste generation and disposal are also associated with urbanization. With the growing affluence of the society, consumption levels have increased. Correspondingly, waste generation has also enhanced. Urbanization too plays a major role in habitat fragmentation and biodiversity loss. McKee *et al.* (2003) and Cincotta *et al* (2000) predict that most of the urbanization is expected to occur in biodiversity hotspots. Forest land is being cleared for the construction of residential areas, roads and other infrastructure development, which is leading to habitat fragmentation.

It is extremely critical for the countries of South Asia to understand the significance of sustainable urbanization to manage resource consumption. Through proper planning, South Asian countries can promote environmentally, socially and economically sustainable societies.

Box 3: Urbanization and Biodiversity Loss

Coimbatore, India is located in the Western Ghats which is in the list of world's hotspots of biological diversity. The Coimbatore forest range is spread over an area of 700 km, flanked by Satyamangalam, Erode, and the Nilgiris forest division in the north and the Palaghat forest division of Kerala in the south. The urban growth of Coimbatore and the increase in economic activities has had some serious impacts on the local environment and biodiversity. Wildlife in the region is affected by habitat destruction, interruption of migratory routes, exposure to invasive species and increasing conflicts with humans. Forests have been cleared on a large scale for agriculture, plantations, residences, highways and other infrastructural projects. Human-elephant conflicts have also increased in the region.

Source: WWF (2011)

2.3 Economic Development

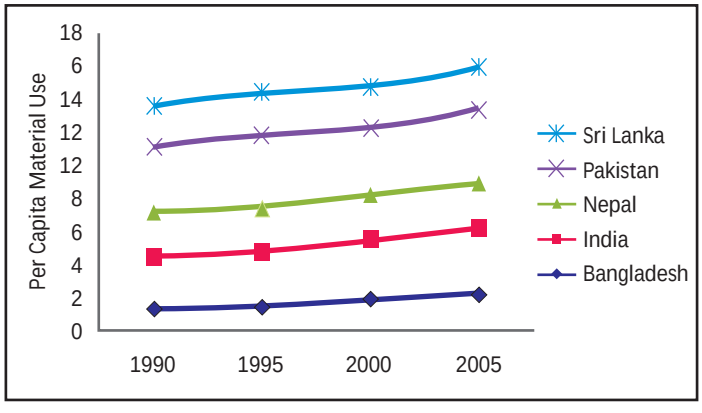
Economic development is closely associated with industrialization and technological innovations. In fact, economic activities have always been considered a means to improve the well-being of humans. At the same time, goods and services are also generated, with the help of technological processes, to improve the quality of human life.

Photo 7: Emission from Industry: a Source of Air Pollution in Bhutan

Photo Credit: K. C. Negydrup

A major portion of the world's industrial activities has shifted to the developing countries in the Asia and Pacific region. In South Asia, India is in the forefront of the industrialization process. It is one of the leading manufacturers of goods. There has also been a significant growth in the share of manufactured goods in India's export (UNIDO 2012). Industrialization, coupled with rapid urbanization, has led to a huge increase in demand in terms of materials and energy. The changing consumption and production patterns and technologies, with the advent of affluence and infrastructure development, have contributed to the degradation of the natural resource base. The extraction and consumption of non-renewable resources like fossil fuels and metals have shown a rapid growth in the region. The share of fossil fuels in the region's energy consumption was 70.4 percent in 2010, an increase of 7.3 percent since 2000 (World Bank 2013d).

Figure 7: Per Capita Material Use in Selected South Asian Countries



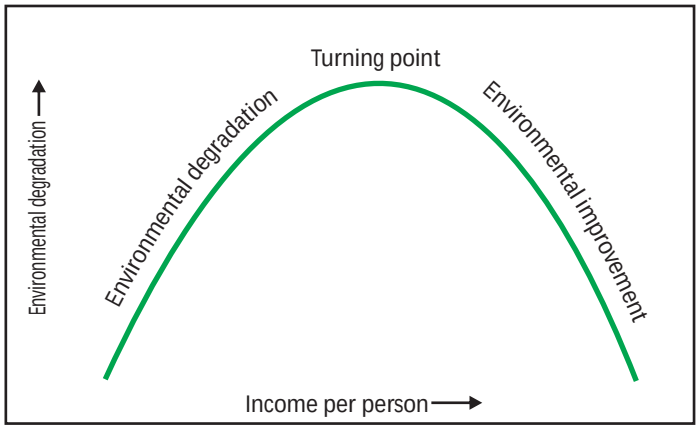
Source: UNESCAP, ADB and UNEP (2010)

Apart from the pressure on resources, industrialization also drives changes in land use. Emissions of pollutants like SO_x, NO_x, CO_2 are the by-products of economic development. Deterioration of air quality can be observed in major cities like Karachi, Dhaka and many others. However, the air quality of Karachi is compensated due to strong breeze from sea leading to effective dispersion. According to Clean Air and Sustainable Environment (CASE)[8], the degrading air quality in Dhaka can be attributed to the brick industries located on the outer skirts of the city. Other signs of stress on resources include water pollution of major rivers due to the dumping of industrial effluents, deforestation as well as extinction of flora and fauna.

8 CASE is a project of the government with the support of World Bank

However, it is argued that economic growth would eventually result in an increase in the environmental quality. Higher levels of income would stimulate the demand for a better environment. People spend either on pollution abatement mechanisms, or on improving efficiency. As economic development progresses and the income grows, the share of industry will go down as services go up; thus, sectoral changes may favour less-polluting sectors (Jänicke *et al.* 1997). This relationship between environmental degradation and economic growth is referred to as the Environmental Kuznets Curve (EKC). It is an inverse U shape curve which suggests that at lower levels of income, economic growth is related to increasing environmental damage. The situation improves as the country's economy grows even further. By contrast, some pollutants have not witnessed any turning point yet. For example, CO_2 emissions have been increasing at an alarming rate for all the countries. Empirically, this can also be true for South Asian economies. Even though environmental awareness is increasing among the people, several industries are still operating inefficient technologies.

Figure 8: Environmental Kuznets Curve



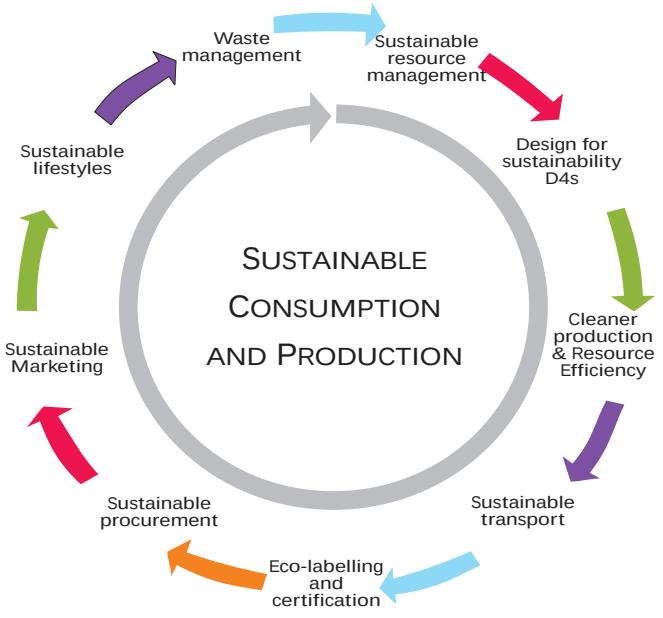
Source: UNEP (2012)

Sustainable Consumption and Production

Resource efficiency and sustainable patterns of consumption and production (SCP) are indispensable in terms of the sustainable development of the region. SCP promotes resource and energy efficiency, sustainable infrastructure, providing access to basic services and environment-friendly jobs and a better quality of life.

Furthermore, economic growth must be decoupled from resource use. Decoupling is essential as the total material extraction and use has increased in recent times. The increasing trend of per capita material use in South Asia has already been depicted in Figure 7. Therefore, it is imperative to use resources more efficiently, reduce wastage, thereby reducing the environmental costs of resource depletion.

Figure 9: Sustainable Production and Consumption



Source: http://www.rona.unep.org/about_unep_rona/SCP/ index.html

Majority of the South Asian population will reside in cities by 2050. Hence, the demand for resources is also escalating, mainly due to a rising incomes of a growing urban population. Demographic shifts and behavioural changes are leading to a reduction in the size of households across the world, including South Asia. This will have an impact on resources as the number of housing units requiring land and building materials will increase. The efficiency of resource use per capita will also reduce. Adding to this is the increasing affluence of the population. It is evident that cities will drive resource consumption in the region (UNEP 2013). Therefore, it is essential to provide services to the increasingly urban population in a sustainable manner. To achieve this, the potential of decoupling in cities should be explored.

Poverty-Environment Nexus

With the improving standard of living in the developing countries and increasing levels of urbanization, the number of motorized vehicles is on the rise. According to the Global

9 SCP can be defined as "the use of services and related products, which respond to the basic needs and provide a better quality of life while minimizing the use of natural resources and toxic materials as well as emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of future generations."

Environmental Outlook 5 (GEO-5), the number of vehicles in the world is growing at a much faster rate than the number of people. In developing countries like India, the number of motorcycles is increasing faster than cars (Pucher *et al.* 2007). The total number of registered vehicles has risen from 55 million in 2001 to approximately 160 million in 2012 (MOSPI 2014). The increase in the number of motorized vehicles has a negative impact on the environment in terms of toxic vehicular emissions and fossil fuel depletion.

Despite the improved standard of living, poverty is still a widespread problem. The World Bank estimates reveal that 398.95 million people lived below USD 38 per month in 2011[10]. Environmental degradation is deeply associated with the spread of poverty in the region. People subsisting below the poverty line depend significantly on the ecosystem services for their livelihoods. The focus of such people is on satisfying their immediate needs rather than achieving future security in terms of resources. The negative effects of poverty include: cutting down forests for fuel; encroachment on marginal lands; overgrazing of grasslands by livestock. However, environmental degradation also exacerbates poverty.

Environmentally Harmful Subsidies

Governments do not damage the environment intentionally. They may not be sensitive towards environmental consequences of the activities they support, but that is not quite the same thing. Rather, when people speak of "environmentally harmful subsidies", they generally mean subsidies that support production, transport or consumption that ends up damaging the environment. The environmental consequences of subsidies to extractive industries are closely linked to the activity per se that is being subsidized, like fishing or logging.

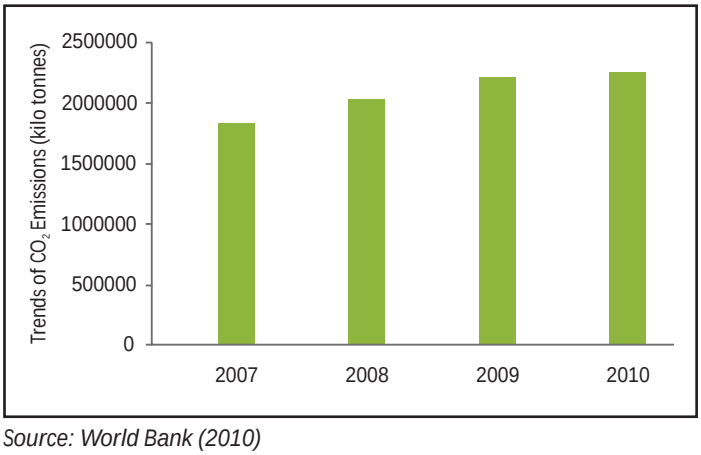
Subsidies to promote offshore fishing are a commonly cited example of environmentally harmful subsidies, which support an increase in the fishing capacity (i.e., subsidies towards constructing new boats), linked to the depletion of important fishery stocks. In other industries, subsidies that promote consumption or production have led to higher volumes of waste or emissions. For example, irrigation subsidies often encourage crops that are farmed intensively, which in turn leads to higher levels of fertilizer use than would occur otherwise. Moreover, irrigation subsidies can lead to the under-pricing of irrigated water, which in turn fosters the overuse and inefficient use of water.

While many subsidies have unintended impact on the environment, well-designed subsidies can prove beneficial in terms of mitigating an environmental problem. In the context of fisheries, these would include subsidies to programmes that help ensure that fishery resources are appropriately managed, regulations are enforced, and R&D is designed to promote less environmentally destructive forms of fishing and processing.

2.4 The Changing Climate

Climate change is an overriding environmental issue of the current times and is being understood as one of the biggest threats to economic and social development. According to the IPCC, climate change refers to a statistically significant variation in either the main state of the climate or in its variability, persisting for an extended period (typically decades or longer). This change may stem from natural internal processes or external forces, or from persistent anthropogenic changes in the composition of the atmosphere or land use. Changes in the atmospheric concentrations of GHGs and aerosols, land cover and solar radiation alter the energy balance of the climate system and are drivers of climate change (IPCC 2007). Anthropogenic activities have resulted in increased emission of GHGs. South Asia has witnessed an increase in CO_2 emissions over the years, as depicted in the graph below. However, the per capita emissions of the region are low as compared to that of developed countries. Increased emissions are responsible for the enhanced greenhouse gas effect,

Figure 10: Trends of CO_2 Emissions of South Asia



Source: World Bank (2010)

10 http://iresearch.worldbank.org/PovcalNet/index.htm?1

leading to an increase in the surface air temperature.
Climate change will have wide-ranging impacts on the environment and a number of socio-economic sectors, including water resources, agriculture and water security, human health, terrestrial ecosystems and biodiversity and coastal zones. Its effects include changes in rainfall patterns, culminating in severe water shortages, flooding, melting of glaciers (causing flooding and soil erosion), and rising temperatures, affecting food security and accelerating the annihilation of a huge number of habitats and species. Rising temperatures cause an increase in the sea level, leading to a greater risk of storm surge, inundation and wave damage to the coastline.

Climate change will impinge upon the poor and vulnerable communities of the developing countries in a disproportionate manner. A number of characteristics of the region like its geography, demography and poverty make South Asia extremely vulnerable to climate change, especially low-lying island states like Maldives. In fact, it will also affect various coastal areas of Bangladesh and India, in terms of inundation caused by the sea-level rise. Climate change will manifest itself in the form of negative impacts on agricultural productivity, water availability, biodiversity and human health in South Asia.

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Photo Credit: Development Alternatives

State and Trends of Environment

Chapter 3

Photo Credit: Sonam Dagay, NEC

This section presents the state and trends of Land, Air, Water and Biodiversity. The state and trends have been analysed under the Drivers-Pressures-State-Responses-Impact (DPSIR) framework. This section uses selected indicators to elaborate on the state and trends of environment. The major issues under each category are highlighted like land degradation and desertification, deteriorating, air quality, groundwater and surface water pollution and loss of biodiversity. Emerging issues like black carbon and ABCs are also dealt with in this section.

3.1 Land

Land influences many spheres of human activity. It acts as a foundation for all the life-sustaining processes on Earth and provides a wide range of ecosystem goods and services on which humanity depends. These include provision of food and water that we consume; regulation of environmental risks such as floods and droughts to which we are often vulnerable; support of natural processes such as soil formation and nutrient cycling on which our production systems depend. The growth and prosperity of the human population depends heavily upon land in agriculture, livestock production and forestry.

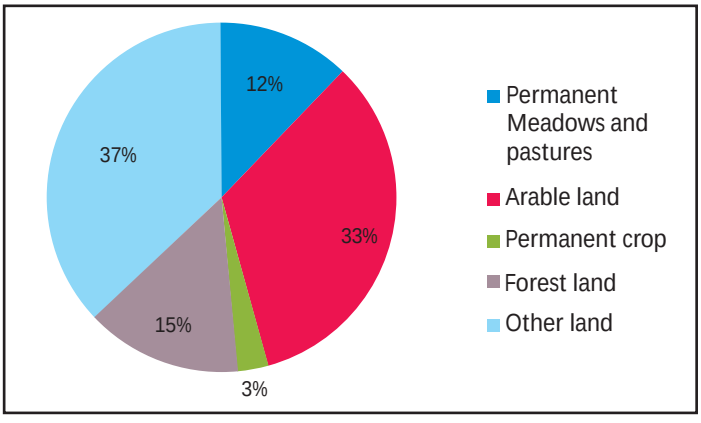
Land resources in this region are under stress due to excess populations, economic growth and urbanization. Ever rising demands for food, feed, fuel, fibre and raw materials create local and distant pressures for land-use change (Lambin and Meyfroidt 2010). Land is an especially an important natural resource for the South Asia as national economies are mainly dependent on agriculture. It has a high economic and social value in the region, and the consequences of land degradation cost its countries and their people, especially the rural population, in terms of reduced production and incomes.

South Asia faces the problem of land degradation in the form of reduction or loss of biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns. These include soil erosion caused by wind and/or water; deterioration of the physical, chemical, and biological, or economic properties of soil; and, long-term loss of natural vegetation. The major reasons for land degradation are the increasing pressure due to changing climate patterns; over-exploitation of natural resources; poor farming practices; inappropriate irrigation; and land pollution including industrial waste and mining tailings.

3.1.1 Land Use: An Overview

As mentioned earlier, South Asia is an agrarian region. Therefore, agriculture is the predominant form of land use. The agricultural land accounted for about 48 percent of the total land area in 2012. Forests account for approximately 15 percent of the land area. The proportion of arable land varies greatly across the region, from the lowest in Bhutan to the highest in Bangladesh. According to FAO, this can be attributed to various factors like topography, variation in soil and climate, the intensity of human pressure on available land and the extent of investments in land, especially irrigation.

Figure 11: Land Use in South Asia in 2012



Source: FAO, Statistics Division (FAOSTAT)

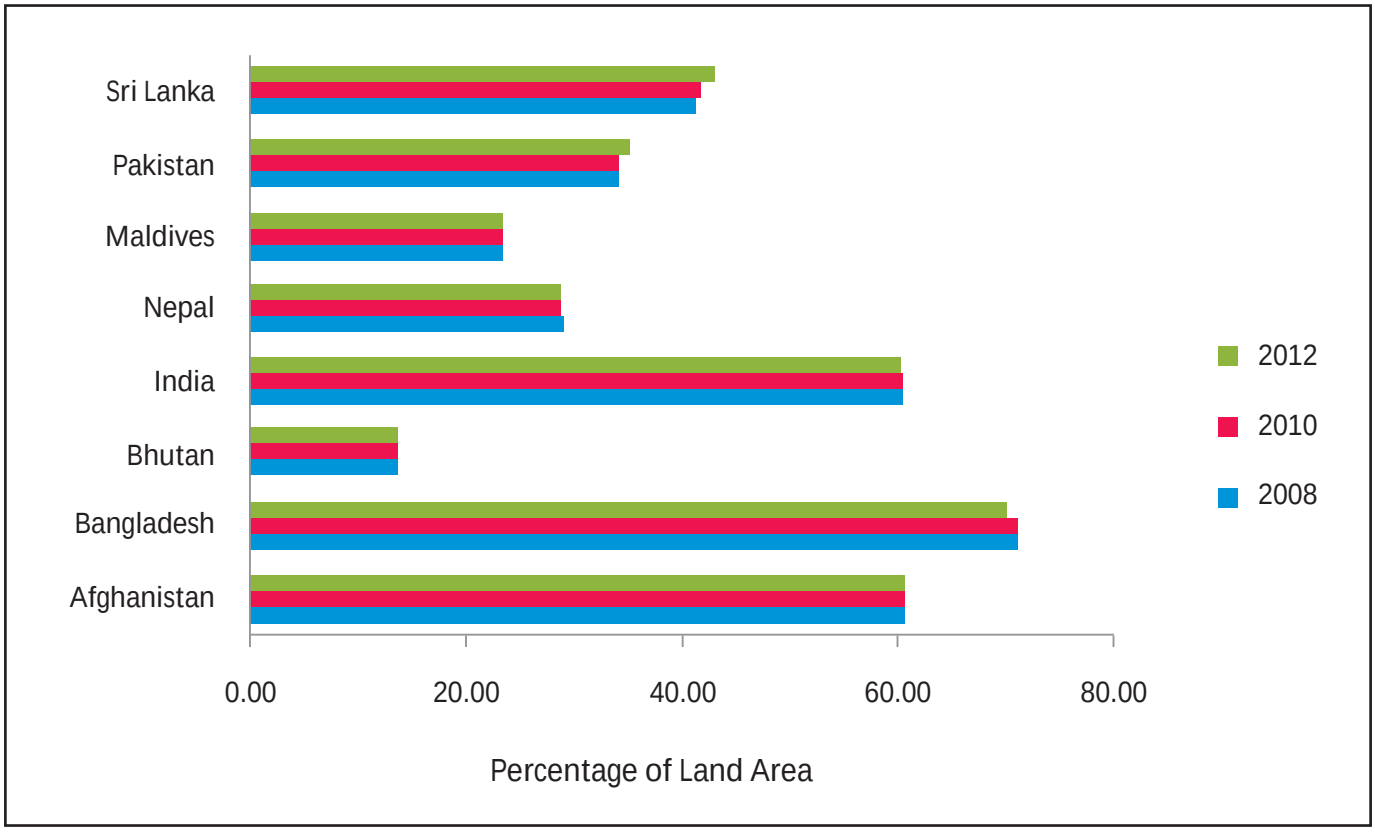
Agriculture in South Asia

The area under agriculture is the sum of all areas under the arable land, permanent crops and permanent meadows and pastures. The area under agriculture in South Asia displayed a slight change in the period 2008-2012. Overall, there has been no drastic change. In fact, it has remained constant in Afghanistan. Bhutan has one of the lowest land area under agriculture. The country-wise trends are depicted in the graph on the following page (see Page 27).

Photo 8: Agriculture is a Major Contributor to the Economy of the Region

Photo Credit: Nabin Baral, ICIMOD

Figure 12: Trends in Agricultural Area in South Asia



Source: FAO, Statistics Division (FAOSTAT)

In 2013, agriculture contributed to about 18.9 percent of the GDP of the region. This share of GDP has decreased from 23.6 percent in 2000 (World Bank 2013). There has also been a slight decrease in the labour force in agriculture Around 47 percent of the workers were in the agricultural sector in South Asia (World Bank 2012). The shift of labour from agriculture to non-farm economy can be attributed to urban migration of workers. Also, the increasing level of education has enhanced the ability of workers to move out of agriculture to better jobs (World Bank 2011).

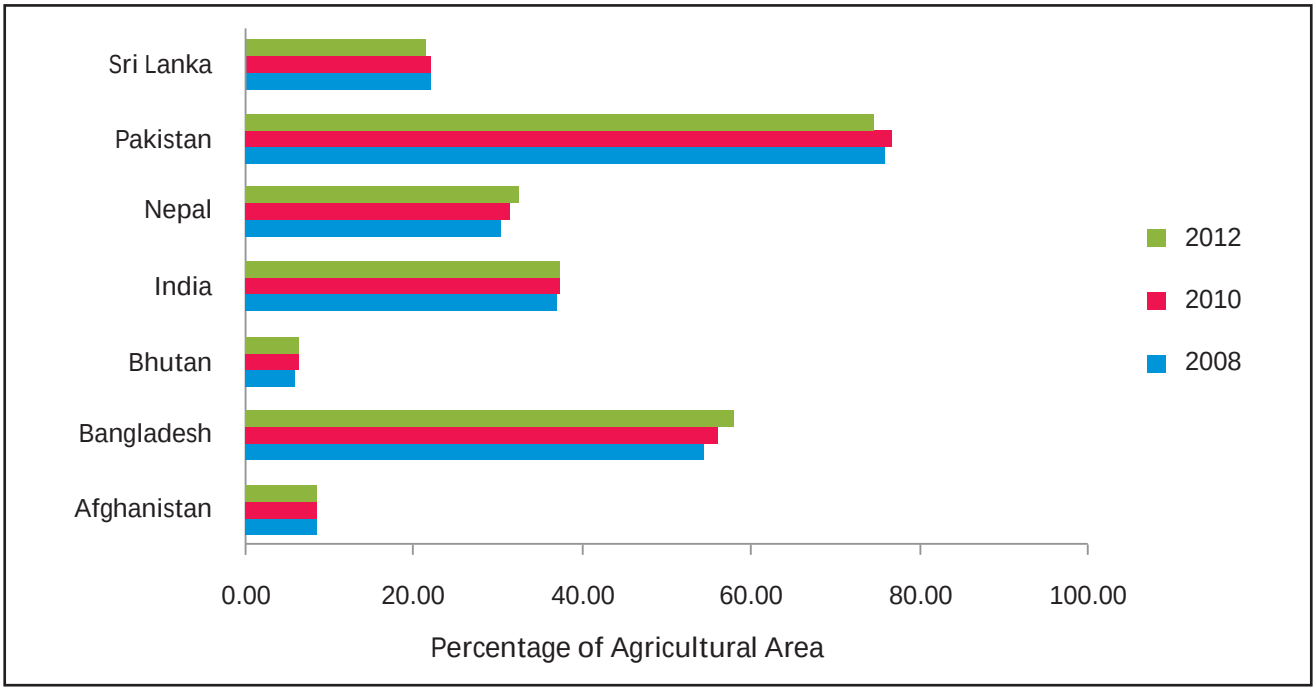
3.1.2 Issues and Pressures

Agricultural Practices

With the emphasis on improving production and yield, agricultural practices have transformed in the region, especially in India, after the advent of Green Revolution. These can be seen through the net increase in area under irrigation, growth in fertilizer and pesticide consumption, and the use of high yielding variety of seeds etc. Although these changes have had many positive effects, they have also led to significant costs. Unsustainable practices in the farming sector have long term implications on the quality of land and health of the environment and the consumer.

Bangladesh has one of the most intensive agricultural practices in South Asia, and appears particularly prone to environmental damage. Indiscriminate use of agro-chemicals, combined with improper irrigation and waterlogging, has resulted in decrease of land quality of Bangladesh (Alauddin and Quiggin 2008). Figure 13 shows the total area equipped for irrigation in the region.

Figure 13: Total Area Equipped for Irrigation as Percentage of Agricultural Area



Source: FAO, Statistics Division (FAOSTAT)

Excessive Chemical Usage

As mentioned earlier, there has been a heavy emphasis on the use of fertilizers and pesticides to raise the agricultural yield. This is evident from the fact that fertilizer consumption in India increased from 2.6 Mt in 1970-71 to 24.91 Mt in 2008-09 (MoEF&CC 2012). Even though the use of pesticides in Bhutan is moderate, its overall use has increased over the years. The pesticide and herbicide use has nearly doubled from 1988/99 to 2004/05 (NEC 2008). It has increased by nearly 39 percent between 2006-07 and 2010-11. According to FAOSTAT, the total nitrogen and phosphate fertilizer usage on arable and permanent crop area increased in Bhutan, India, Nepal and Pakistan in the period 2006-2010. The highest increase was observed in India where consumption increased from 113.9 to 144.8 kg per hectare. On the contrary, Afghanistan, Bangladesh, Maldives and Sri Lanka witnessed a decreasing trend. The usage in Maldives decreased most drastically-from 33.8 to 1.8 kg per hectare.

These practices have resulted in improved agricultural productivity. Foodgrain production in India has increased by over four-fold since 1950s. However, the increasing use of fertilizers increases the toxicity of soil. High levels of sodium and potassium contained in fertilizers can also have a negative impact on soil and its pH. Continuous application of acid-forming nitrogen fertilizers causes a decrease in the soil pH. Use of herbicides and pesticides also reduces the soil's resistance to diseases by harming the soil biota. Apart from the harmful effects to soil, run-off of fertilizers also deteriorates water quality.

Unsustainable Irrigation

According to the reports of the International Water Management Institute (IWMI), agriculture uses nearly 70 percent of all available freshwater resources in South Asia. Irrigation is crucial for enhancement in food production. It is also responsible for enhancing the income of rural households as it promotes crop diversification and reduces the risk of drought.

However, many of the irrigation systems are expensive and inefficient. The traditional method of flood irrigation is still dominant in most parts of the region. In addition to wasting water and pollution of groundwater and surface water bodies from fertilizers and pesticides, resulting in deterioration of water quality, unsustainable and excessive irrigation has the potential to increase soil erosion. Inefficient irrigation also contributes to water-logging, and leaching and salinization of soil. Surface irrigation is the most commonly used method in the region. In 2009, 97.7 percent of the area was under surface irrigation. Only 2.2 percent of the area was under efficient irrigation techniques, like sprinkler and localized irrigation (FAO

2012a). Such efficient techniques and improved drainage would prevent the damage to agricultural land. Although modern technologies and cheap pricing of water have helped in the expansion and intensification of irrigation, it is not without negative effects.

Over-extraction of groundwater for irrigation and waterlogging causes salt water intrusion in coastal areas. This will render the soil unsuitable for crops that cannot adapt to the high salt concentrations. Bangladesh, India, Pakistan and Sri Lanka are affected by water logging and soil salinization. An estimated 146.82 million hectares area in India suffers from various forms of land degradation due to water and wind erosion and other problems like alkalinity/salinity and soil acidity due to water logging (MoEF&CC 2009). 25 percent of irrigated land suffers from various levels of salinity, with over 1.4 million hectares being rendered uncultivable due to salinity. In Sri Lanka, the extent of land affected by salinity was estimated at 18,000-45,000 hectares in 1972, caused primarily through natural processes. Human induced salinization can occur due to water logging in farmlands owing to inefficient irrigation systems and blocking of drainage channels.

Box 4: Economic Losses due to Salinity in Pakistan

The problem of salinity in Pakistan is compounded by mismanagement of irrigation. It imposes economic losses due to reduced yields and changes in farming practices or cropping mix. The total annual yield reductions from salinity are estimated at Rs. 15-55 billion. If lost opportunities from cropping on the 1.4 million hectares of land with high salinity are included, it adds a further Rs. 15.25 billion. This brings the total estimated cost of salinity to Rs. 30-70 billion, with a mean cost of Rs. 55 billion, or 0.9 percent of GDP in 2004.

Source: Environment and Climate Change Outlook of Pakistan

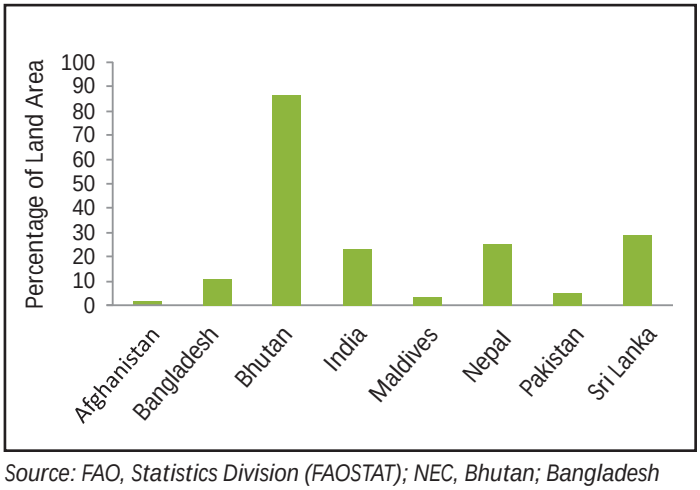
Changing Forest Cover

South Asia depicts a marked diversity in the forest types, ranging from montane forests, rainforests, conifer and broad-leaved forests to mangroves. Unfortunately, barring Bhutan, the forest cover of these countries is lower than the world average of 31 percent. As a matter of fact, Bhutan has the highest percentage of forest cover. Commercial logging of timber takes place in forest management units (FMU). Currently, 18 FMUs are operational, covering roughly eight percent of the total forest area. The forest area of Bhutan has expanded over the past 20 years. Despite the net increase, local deforestation can be observed in recent times. The forest and woodland cover of Sri Lanka was estimated to be around 29 percent in 2012. Plantation forests amount to one percent of the total geographical area of the country (UN-REDD 2012).

Population pressure, poverty and absence of strong institutional framework have often been considered as the predominant underlying cause of forest depletion and degradation in India. 21.23 percent of the total geographical area of India (i.e. 23 percent of land area) is covered by forests. The forest cover of India has largely stabilized. An increase of 5871 km^2 was observed from 2011 (FSI 2014). In 2010, plantation forests accounted for 15 percent of the total forest area of the country (FAO 2012b). However, tackling forest degradation is a challenge because of unsustainable harvesting of various forest products and a variety of drivers of degradation.

The forest area of Bangladesh has also experienced a decrease in the forest cover. The annual deforestation rate was estimated to be around 3.3 percent. However, forest cover loss has not been comprehensively studied (Department of Environment 2010). Only 5.2 percent of land area is under forest cover in Pakistan (Government of Pakistan 2013). The forests found in Maldives are mainly littoral and mangrove forests. The arable land in Maldives is already limited and is characterized by poor soil and low freshwater supplies (Ministry of Environment and Energy 2011), resulting in the limited forest area.

Figure 14: Percentage of Forest Area in South Asian countries in 2011



Source: FAO, Statistics Division (FAOSTAT); NEC, Bhutan; Bangladesh Bureau of Statistics

Figure 5: Change in Forest Area (Percentage of Land Area) from 2000 to 2012

Countries	Forest Area (2000)	Forest Area (2012)
Afghanistan	2.1	2.1
Bangladesh	11.3	11.0
Bhutan	78.9	85.8
India	22	23
Maldives	3	3
Nepal	27.2	25.4
Sri Lanka	33.2	29.2

Source: FAO Statistics Division (FAOSTAT)

The major threats to forests in South Asia stem from the region's developmental processes. Countries are faced with enormity of challenges of meeting aspirations of fast-growing population and resultant increase in demand for various forest products as well as pressure on forest and agricultural land for urbanization, infrastructure, mining, hydro-power, industrialization and other development projects. Apart from these, forest fires and grazing pressures are also some of the real dangers to the South Asian forests.

Shifting Cultivation

Shifting cultivation is also known as 'slash and burn' cultivation and *tseri* in Bhutan. In this system, plots of land are cultivated temporarily and are allowed to revert back to its natural vegetation by leaving them fallow for a period of time. However, shortening of fallow cycles due to increased cultivation requirements has triggered land degradation. This practice is prevalent in South Asia and is still being followed in the eastern and the north-eastern regions of India like Assam and Arunachal Pradesh. *Tseri* used to be widely practiced in most part of eastern and central-eastern Bhutan. However, under the Land Act of Bhutan 2007, shifting cultivation is banned and this has contributed to a wide reduction of the practice.

Degradation due to Livestock

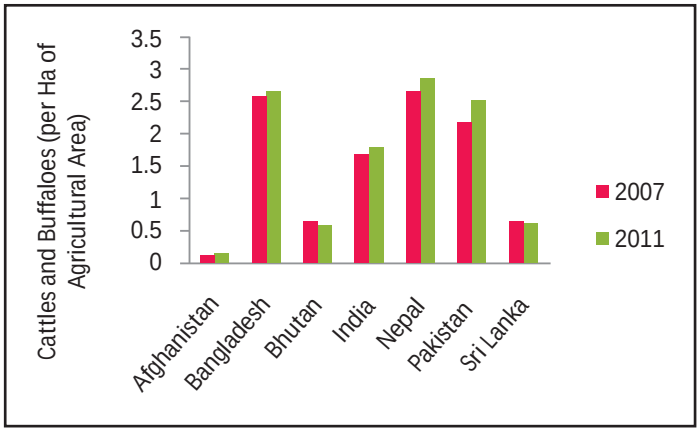
Livestock are utilized for various reasons like meat, eggs and dairy production, as well as for draught power or future breeding. Non-arable agriculture has intensified in a few countries in South Asia, as illustrated by the graph in the adjoining column (Figure 15).

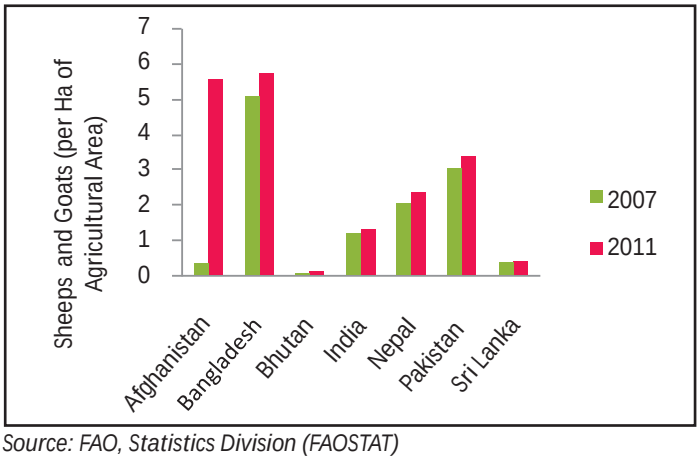
Environmental implications are associated with the increasing numbers of livestock. Loss of vegetation due to excessive cattle grazing and improper management has become a growing concern in the region. It may lead to decline in productivity of land, soil erosion and deforestation.

Photo 9: Shifting Cultivation has led to Deforestation in the Region

Photo Credit: Sanat Chakraborty, ICIMOD

Figure 15: Livestock Density per hectare of Agricultural Land





Source: FAO, Statistics Division (FAOSTAT)

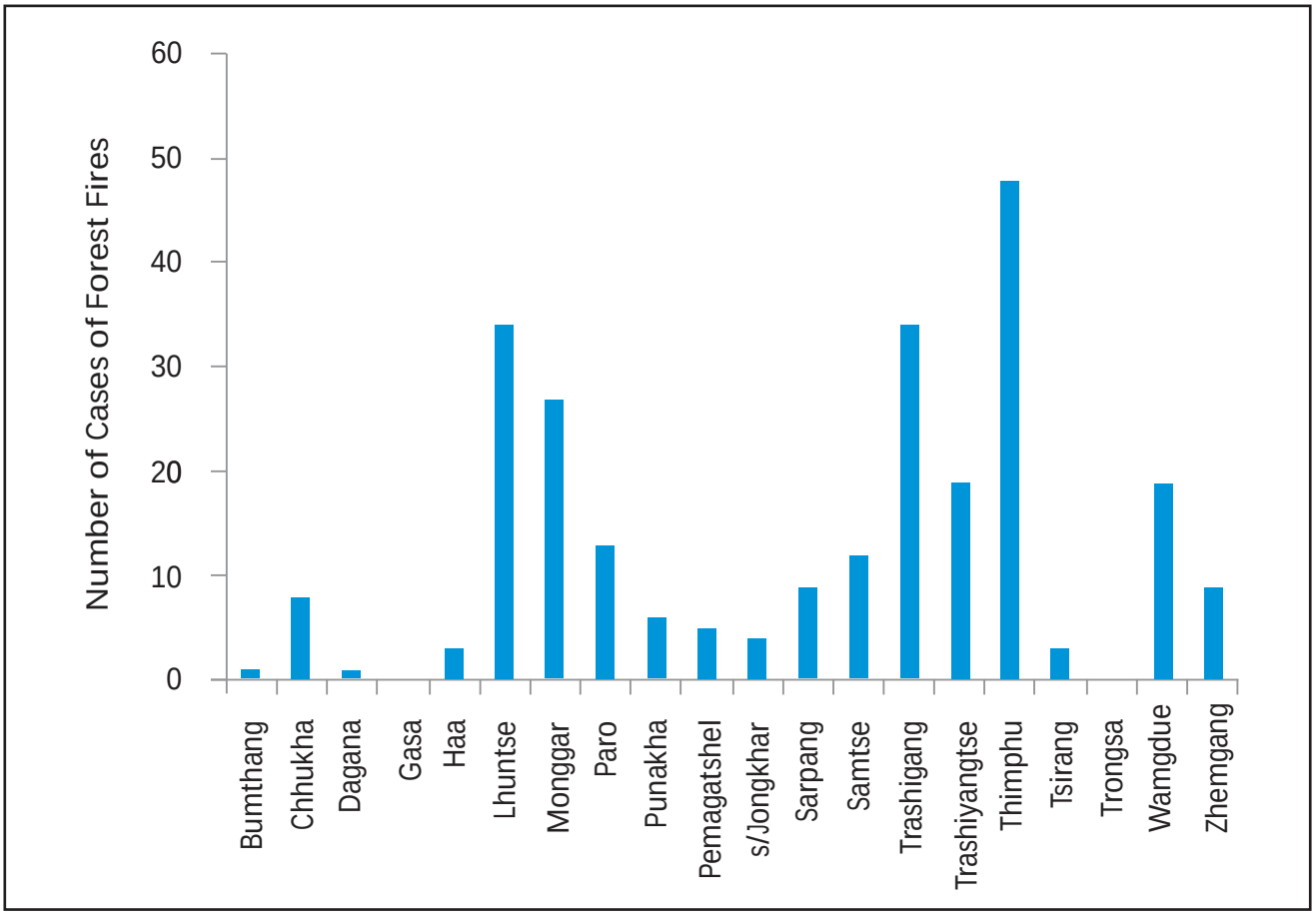
Land Degradation

Globally, land degradation affects 33 percent of the Earth's land surface, with consequences for more than 2.6 billion people in over 100 countries (GEF 2011). Land degradation is a major problem in all South Asian countries. Afghanistan and Bhutan, due to their rugged topography and altitude, have limited resources of productive land. These land resources are at risk from the various types of land degradation.

Afghanistan has been severely affected by land degradation for decades due to its socio-economic and geographical circumstances. According to a global assessment of soil degradation (GLASOD), 16 percent of the land area of the country is severely affected due to anthropogenic activities (NEPA 2008) and barren land occupies one-third of the total land area. Soil fertility has also decreased due to poor agricultural practices.

In Bhutan, water induced degradation, specifically gullies, landslides, ravine formation and local flooding, is more prominent and devastating. Surface erosion is extensive but less severe. In-situ chemical degradation, such as depletion of soil organic matter and nutrient mining, and in-situ physical degradation, such as top-soil capping and sub-soil compaction, are also prominent. Land degradation threatens the livelihoods of 69 percent of population who depend on agriculture. According to Bhutan Land Cover Assessment 2010, 0.54 percent of the land area is degraded (NSSC and Policy Planning Division 2010). Frequent occurrences of forest fires often lead to the degradation of forest lands. In all, 504 incidents of forest fires have occurred in Bhutan between 2001 and 2010, affecting 56,767 Hectares of land[11]. 8,981,017 hectares i.e. 19.78 percent of the total land area of India suffers from

Figure 16: Districtwise Forest Fire Cases in Bhutan (2006-2011)



Source: NEC, Bhutan

11 www.dofps.gov.bt

Photo 10: Forest Fires in Bhutan

Photo Credit: Department of Forest Park Service, Ministry of Agriculture and Forests

degradation.

Land degradation in Pakistan is mainly due to water and wind erosion, salinity and water logging. Around 44 percent of the total farmlands in Sri Lanka suffer from some form of land degradation or another, and about 30 percent of the land in the dry zone is degraded and unsuitable for agriculture, while 30 percent of tea land in the wet zone is considered marginal or uneconomical for continuous cultivation (Ministry of Environment 2009).

Soil Erosion

Soil erosion by water and wind is a major issue of concern. It is estimated that one-sixth of the world's soil has already been degraded by water and wind erosion. In India, about 130 million hectares of land (or 45 percent of the total geographical area) is affected by soil erosion through ravine and gully, shifting cultivation, cultivated wastelands, sandy areas, deserts and water-logging. Soil erosion rates in the hilly regions of Sri Lanka could be as high as 100 tonnes per hectares per year. A large portion of the land in Nuwara Eliya, Kandy and Matale districts is moderate to high levels of vulnerability for soil erosion (Ministry of Environment 2009). In all, 1.7 million hectares of land is affected by water erosion in Bangladesh (Hasan and Alam 2006). Nearly 45.5 percent of Nepal is seriously affected by water erosion. In all, 4 percent of the area, mostly in high altitudes and trans-Himalayan region, is affected by wind erosion (MoEST 2008). About 16-18 million hectares of land area in Pakistan is affected by erosion. Water erosion is prevalent in Khyber Pakhtunkhwa, Sindh and Northern areas. About 3-5 million hectares of land is affected by wind erosion in arid regions of Punjab, Sindh and Baluchistan.

Coastal erosion is the main land degradation problem faced by Maldives. In fact, beach erosion is a serious problem on about 50 percent of the atoll islands. Ecological impacts of beach erosion include direct loss of coastal vegetation and increased risk of flooding and adverse impacts on inland vegetation. Urban development without proper land use plans and removal of vegetation is another trend on the rise. Housing, infrastructure development and agriculture are all encroaching on the limited vegetation areas including mangroves and pond areas.

Dry Lands

Dry lands are arid, semi-arid and dry sub-humid areas. When land degradation occurs on dry lands, it often creates desert-like conditions. It is often caused by human activities, such as overgrazing, over-cultivation, deforestation and poorly planned irrigation systems. Extreme climatic events, such as droughts and floods, can also accelerate the process of land degradation.

Afghanistan's vulnerability to desertification is one of the highest in the world (as three-fourth of the country is vulnerable to desertification) (NEPA 2008). According to the 2006 National Report of MAIL, as highlighted in Afghanistan's National Communication to CBD, 75 percent of the country's area in the northern, western and southern regions is affected by desertification. In India, 228.3 million hectares of geographical area comprises arid (50.8 million hectares), semi-arid (123.4 million hectares) and dry sub-humid regions (54.1 million hectares). Western parts of Rajasthan and Kutch are chronically drought-affected. Droughts occur frequently in the areas affected by desertification (MoEF&CC2009). In Pakistan, desertification and degradation affect nearly 68 million hectares of land. About 28.24 percent of the total land in Nepal is affected by desertification (MoEST 2008). Consequences of desertification include diminished food production, soil infertility and a decrease in the land's natural resilience; increased downstream flooding, reduced water quality, sedimentation in rivers and lakes, and silting of reservoirs and navigation channels; aggravated health problems due to wind-blown dust including eye infections, respiratory illnesses, allergies, and mental stress. Loss of livelihoods after forces the affected

Photo 11: Desertification in Afghanistan

Photo Credit: NEPA, Afghanistan

people to migrate.

3.1.4 Initiatives to Combat Land Degradation

Responses to land degradation and forest loss include watershed programmes, afforestation programmes, awareness and capacity building programmes among others. In order to cope with the loss of its forests, Department of Forest and Park Services, Bhutan, has been running various programmes like the participatory forest programme for community-based forest management and capacity development, non-wood forest resource development programme, forest protection programme to strengthen land-use monitoring, regulation and protection of forests from poaching and disease and many others. The government has established the Ugyen Wangchuk Forest and Environmental Institute to promote education and research as well as strengthen the capacity of the nation for natural resource management.

Promotion of forest-based livelihoods is a key measure for management of forests. Agroforestry may also be given impetus for creating more livelihood opportunities as the region is well suited for tree farming. The Joint Forest Management Programme (JFM) of India has emerged as an important intervention in the management of forest resources. The basic concept of this initiative is to establish grassroots community-based institutions for protection and management of forests. It recognizes the livelihood and sustenance needs of the people through the principle of 'care and share'. More than 100,000 JFM committees involve around 20 million people and manage approximately 22 million hectares of forest area. Active involvement of local communities has contributed significantly to checking deforestation and protecting forest and tree cover of India. The Green India Mission aims to increase the forest and tree cover by 5 million hectares and improve the quality of another 5 million hectares. This includes a target of around 2.3 million hectares of land under agroforestry through various support activities, like raising of nurseries and quality planting material, technology transfer, information dissemination, training and capacity building of farmers. The Integrated Watershed Development Programme was launched in India in the year 1989-90 to develop the wastelands on watershed basis, to strengthen the natural resource base and to promote the overall economic development of the resource-poor and disadvantaged sections of people inhabiting the programme areas. Similar programmes are also running in

Box 5: Local Efforts to Combat Desertification in Pakistan

To address land degradation and desertification, women of Morkhoon in the mountain desert areas of Pakistan play a critical role in natural resource management. With the support from the private Aga Khan Foundation (AKF), several women's organizations provide strong institutional support to run a credit and savings programme to better manage natural resources and prevent desertification. The AKF has promoted forest plantations on the boundaries of fields, communal land, private land and other areas where original vegetative cover has disappeared. This has helped to overcome fuelwood and fodder shortages. The women have created committees to monitor forest use and grazing. They have also planted trees on family plots and have switched from monoculture practices to crop rotation. These actions not only check the desertification process, they also provide the women with income from selling fruits from the trees.

In an effort to check desertification, the Government of Pakistan has also launched a project named 'Sustainable Land Management (SLM) to Combat Desertification in Pakistan'. The overall goal of the project is to combat land degradation and desertification in Pakistan in order to protect and restore ecosystems and essential ecosystem services that are key to reducing poverty. The project is being implemented in two phases, with the first phase focused on creating an enabling environment for SLM and piloting innovations, and the second phase drawing on lessons learned to deepen the policy and institutional commitment to SLM and completing demonstration projects that can later be scaled up and replicated. The phase I of the initiative was launched in 2009.

Source: UNCCD (207), www.slmp.org.pk

Bangladesh, Nepal, Pakistan and Sri Lanka .
Nepal is implementing the concept of community forestry. In fact, the community forests are national forests handed over to a Forest User Group (FUG) for their development, conservation and utilization for the collective benefit of the community. The policy of the government is to adopt community forestry for all successive mid-hills and high mountain forests, as well as for some Tarai districts. More than 15,000 FUGs and other Community based Forest Management Groups are present in Nepal. Of this, 13,528 are affiliated with the Federation of Community Forestry Users, Nepal.

Several other countries are running afforestation programmes. The area afforested in Pakistan was 12.9 hectares in 2008-09 (FBS 2009). The Government of Bangladesh plans to create a database of all land resources and land zoning information to mitigate land degradation by ensuring the proper use of land. It is also developing a coastal land zoning project. It is going to introduce laws to limit all such activities that promote land degradation like deforestation.

Sri Lanka has introduced financial incentives to increase the forest area. The Sri Lankan government's concern is reflected in the policies enacted. Policies in relation to soil conservation through management of natural resources are spelt out in the National Land Use Policy, Forestry Sector Master Plan and the Agricultural Policy. On the other hand, Nepal and Afghanistan are yet to develop a National Land Use Policy. All the countries have ratified the United Nations Convention to Combat Desertification.

It is suggested to develop a holistic approach to achieve balance between forest land and agricultural land. SAARC can take up this initiative. In fact, SAARC may also conduct capacity building programmes to strengthen national forest programmes of member countries towards implementing Non-Legally Binding Instrument on All Types of Forests. The countries can also collaborate on common research programmes and share experience and good practices for sustainable forest management.

Organic Farming

Organic farming aims to enhance the ecosystem health, as it is based on minimal external inputs and aims to make best use of local natural resources. Synthetic pesticides, mineral fertilizers, synthetic preservatives, pharmaceuticals, genetically modified organisms (GMOs), sewage sludge and irradiation are prohibited in organic farming. The land area under organic management has been steadily increasing worldwide for several decades, reaching 37.2 million hectares in 2011, up from 11 million hectares in 1999 (FAO 2013). There is a growing interest in organic farming in South Asia as well. India has the largest proportion of land under organic farming.

Table 8: Area under Organic Agricultural

	2007	2008	2009	2010	2011
Afghanistan	0.02	0.04	0.06	0.06	0.06
Bangladesh	-	0.5	1.20	0.80	6.80
Bhutan	0.06	0.06	-	-	21
India	1030.30	1018	1180	780	1084.30
Nepal	8.30	8.50	8.20	9.80	9.89
Pakistan	25	24.50	20.30	22	24.90
Sri Lanka	17	22.30	21.20	22.30	19.50

Source: FAO Statistics Division (FAOSTAT)

Area (1000 Hecteres) in South Asia

Conclusion

Basically an agrarian region, agriculture is the predominant form of land use in South Asia. The area under agriculture has not shown a drastic change in recent years. Land degradation will put immense pressure on the land sources, which are already under stress to meet the food demands of the growing population. The farming techniques used to increase agricultural productivity are contributing to land degradation, which is exemplified by the excessive use of fertilizers and pesticides and intensive irrigation. Afghanistan, India and Sri Lanka are severely affected by land degradation. However, a data gap does exist since a recent assessment on the extent of degradation has not been done. The forest cover in countries like India and Bhutan has improved. This can be attributed to the afforestation and forest management programmes being run in these countries. Other nations are also making various efforts to increase their forest cover.

However, several data gaps on the extent of land degradation exist in the region. A comprehensive study needs to be done to calculate the exact extent of degradation in the region.

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3.2 Air

Air pollution in urban areas is dangerous for human health and widespread as well, especially in developing countries where the process of urbanization is rapidly taking place (Gwilliam *et al*. 2004). Air pollution in the cities of South Asia has grown exponentially with progressing industrialization and urbanization. Pollution and degrading air quality have multiple effects on the ecosystem, crop productivity, ozone depletion and human health. In fact, respiratory diseases are one of the leading causes of mortality (WHO 2002).

3.2.1 Issues and Pressures

Vehicular Emission Load

Economic development and urbanization are associated with the increasing demand for transport. In response to this, the number of vehicles in the world is growing at a much faster pace than the number of people. An increase in private vehicle ownership can also be observed in the middle and low income countries. Such a trend is also witnessed in South Asia as well. The largest number of motor vehicles are found in India and Pakistan. The total number of registered motor vehicles in India has increased by approximately 65 percent in the decade 2001-2012 (MOSPI 2014). Motor vehicles registered in Pakistan in 2011 were 9,080,437 (PBS 2012). The number of vehicles in Bhutan also increased from 35,703 in 2007 to 62,697 in 2011 (NSB 2012). A similar trend was observed in Maldives, where 44,380 vehicles were registered by 2009, with a major share of motorbikes and cars accounting for only seven percent of the total vehicles (Ministry of Environment and Energy 2011). The environmental implication of this trend is the increase in vehicular emissions due to the combustion of fossil fuels in vehicles.

Photo 12: Increasing Number of Vehicles in Bhutan

Photo Credit: Tshering Tashi

Industrial Sector Growth

Industrialization has resulted in profound deterioration of air quality in the region. Rapid industrialization has resulted in the emergence of industrial centres in South Asia without proper pollution control mechanisms. In all, 54.85 percent growth in the registered factories was estimated in India alone from 1987-88 to 2009-10 (MOSPI 2014). Bhutan registered an increase of 24.30 percent in industries from 2007 to 2011 (NSB 2012). Major industries that contribute to air pollution in Bhutan are the cement production units, chemical processing and mining units.

3.2.2 Deteriorating Air Quality

Particulate Matter

Particulate matter (PM), especially $PM_{2.5}$, is the most important air pollutant causing damage to human health (WHO 2011). Major sources of PM in the region can be attributed to transport and industry. High concentrations of ambient PM have been recorded in major cities of India and Pakistan. Delhi had an exceptionally high concentration of Suspended Particulate Matter (SPM) and PM_{10} as compared to other cities in India. In Bhutan, the particulate concentrations have been found to rise in winters. This can be attributed to the emission from point sources, the constant winter high pressure system that sits over the South Asian region and temperature inversions during dry winter seasons. PM_{10} concentrations of the South Asian countries, except Maldives are exceptionally high as compared to the WHO guidelines of 20 µg/m^3 annual mean.

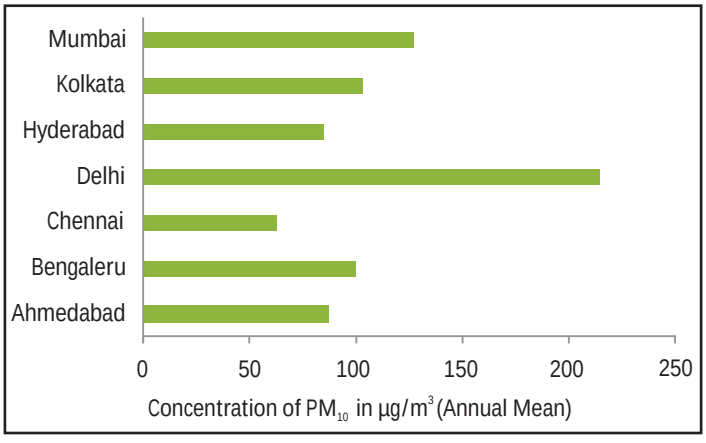
Table 9: PM_{10} Concentrations at Country Level in 2011

S. No.	Countary	PM_{10} Level (µg/m^3) (2011)	$PM_{2.5}$ Level (µg/m^3)
1	Afghanistan	63.47	84 (2009)
2	Bangladesh	120.57	79 (2013)
3	Bhutan	16.18	10
4	India	99.71	59
5	Maldives	21.46	9
6	Nepal	109.95	50
7	Pakistan	170.97	101 (2010)
8	Sri Lanka	62.42	28[12]

Source: World Bank (2011a); WHO (2014)

12 The figures without years have not been measured. These data have been converted to $PM_{2.5}$ from PM_{10}

Figure 17: Air Quality (PM_{10}) of Major Cities of India in 2008

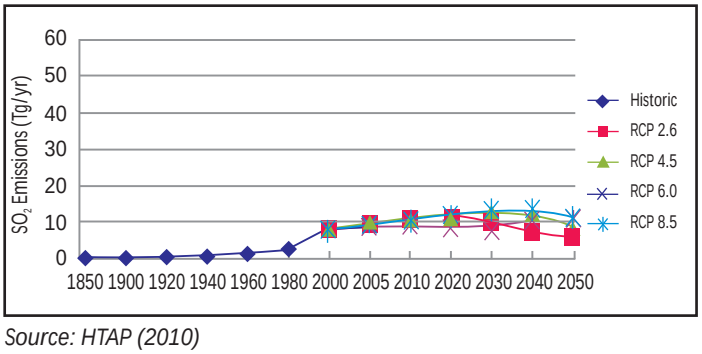


Source: MOSPI (2014)

Other Pollutants

Sulphur dioxide (or SO_2) emissions are predominantly from fossil fuel combustion in power generation, industry and transport. Emissions in the region increased steadily from 1850-1950. There was a rapid rise in the emissions after 1950. According to Representative Concentration Pathways (RCP), it is projected that emissions from energy, industry and waste sectors would rise from 2000 to 2030 and then fall. However, residential emissions are projected to increase in South Asia (HTAP 2010). This set of four new pathways was developed for climate modelling community as a basis for near and long-term modelling experiments.

Figure 18: SO_2 Emissions: Regional Trends and Future Predictions for South Asia

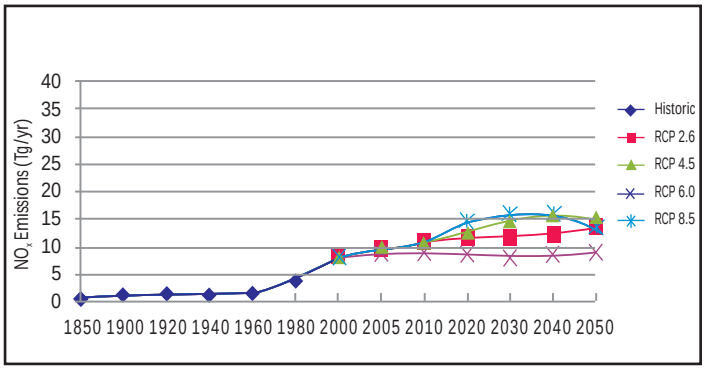


Source: HTAP (2010)

Nitrogen compounds are emitted in the atmosphere as NO_x (mainly from transport and industry sectors), and ammonia and nitrous oxide (mainly from agriculture). South Asia has seen a steady increase of NO_x emissions over the years (as depicted in the figure 19). Much of the emissions are from energy, industry and waste sectors. These emissions are predicted to increase in the future as well.

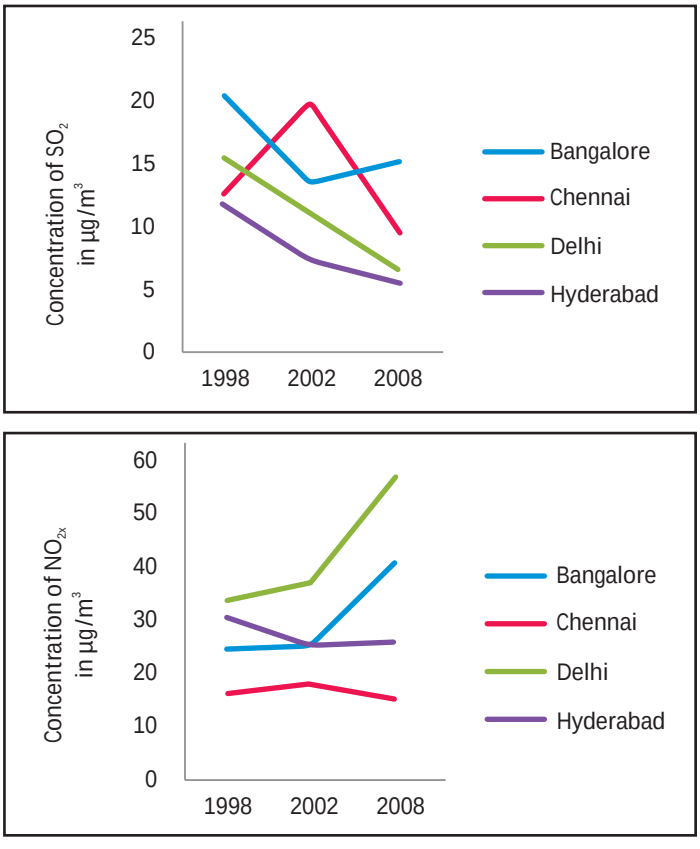
During the last few years, a decreasing trend has also been observed in SO_2 concentration in cities like Delhi, India. This can be attributed to measures such as reduction in sulphur in diesel and the popularization of LPG instead of coal and biomass as domestic fuel. On the other hand, NO_2 levels show an increase in the pollution levels.

Figure 19: NO_x Emissions: Regional Trends and Future Predictions for South Asia



Source: HTAP (2010)

Figure 20: Yearly Trends of Levels of SO_2 and NO_2 in Major Cities of India



Source: MOSPI (2014)

13 The RCPs are not a complete package of socioeconomic, emissions, and climate projections. They are consistent sets of projections of only the components of radiate forcing that are meant to serve as input for climate modeling, pattern scaling, and atmospheric chemistry modelling. However, it doesn't indicate which policy or behavioural changes society could make that would lead to scenarios. These RCPs are named on their radiative forcing target level for 2100. RCP2.6 is a low emissions scenario. The RCP8.5 is representative of the high range of non-climate policy scenarios. RCP4.5 and RCP6.0 are intermediate scenarios which assume stabilization in emissions

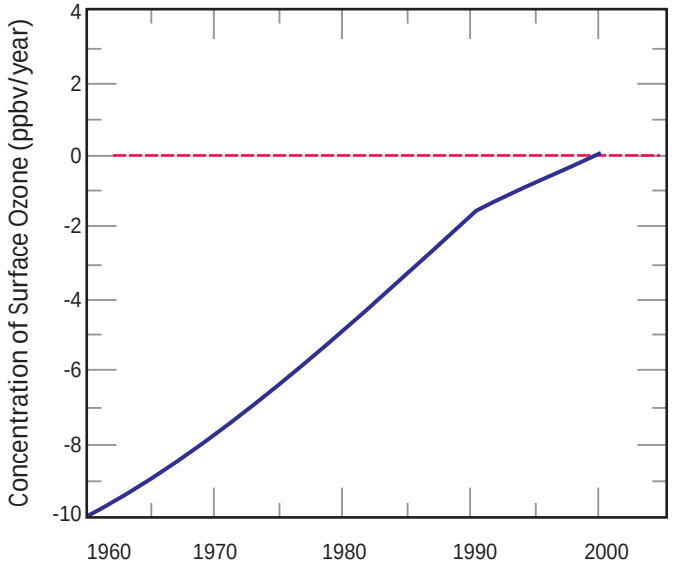
Air quality data of Pakistan is depicted in the table below:

Table 10: NO_x and SO_2Concentration in Pakistan from 2008-2010

City	Type of Area	Concentration of SO_2 ($\mu g/m^3$)	Concentration of NO_x ($\mu g/m^3$)
Lahore	Urban Area	26.8	48.8
Rawalpindi	Residential Area	49	189
Faisalabad	Residential Area	161	472
Sheikhpura	Residential Area	26.40	78
Gujranwalla	Residential Area	52	82

Source: FBS (2010)

Figure 21: Regional Changes in the Concentration of Surface Ozone in South Asia, 1960-2000



Source: HTAP (2010)

With rapid urbanization, Afghanistan's cities also suffer from deteriorating urban air quality. A study of Kabul city revealed that 60 percent of the population is exposed to elevated concentrations of particulate matter PM_{10}, NO_x and SO_2 (NEPA 2008). Air quality monitoring in Bhutan is conducted in Thimpu only. Recorded ambient air quality data for Thimpu indicate that the concentration of oxides of sulphur and nitrogen are presently below the detectable level.

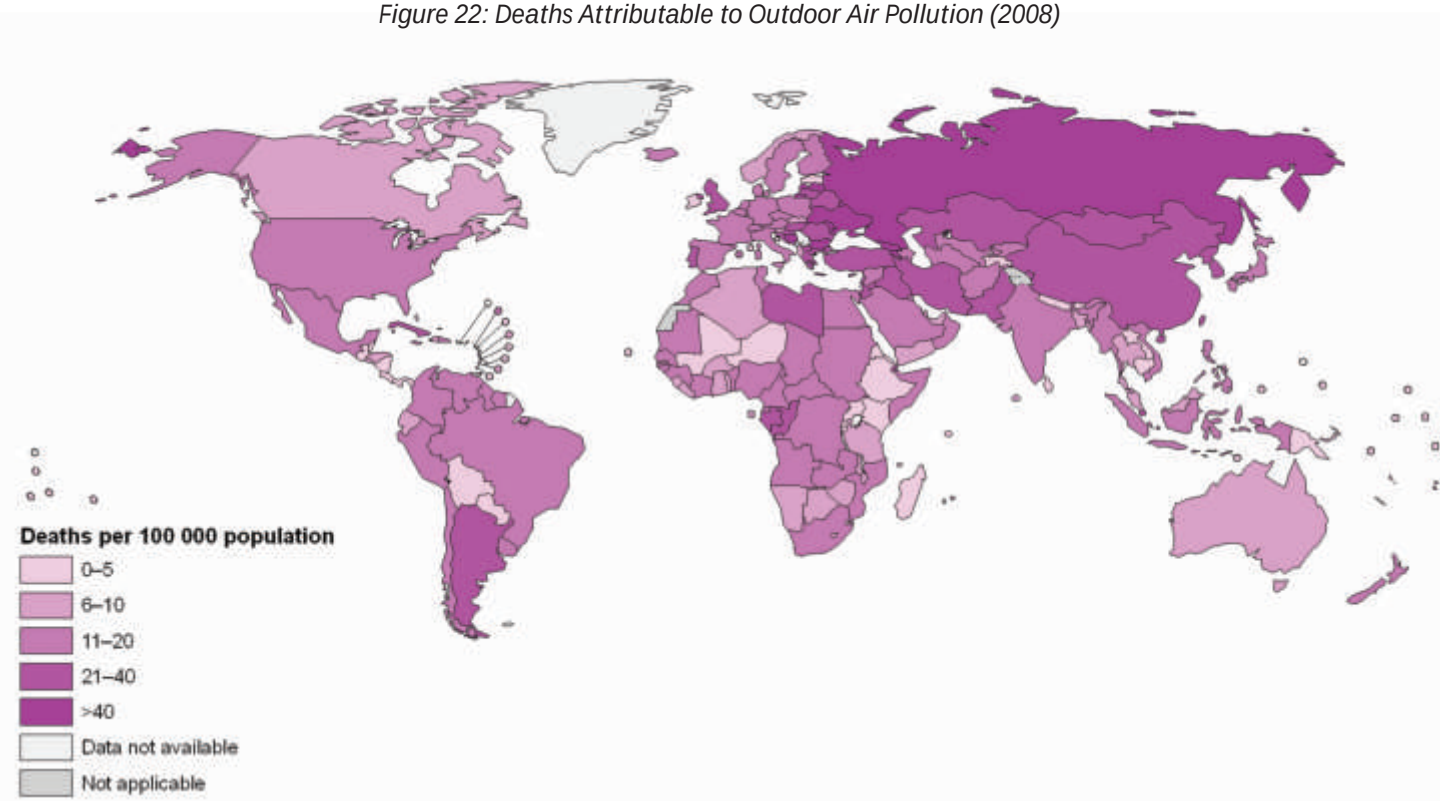
The ground-level or surface ozone (O_3) refers to concentrations at ground level that affect both human health and ecosystem. Globally, both background and peak concentrations of tropospheric O_3 have been steadily increasing in rapidly industrializing countries. Historically, South Asia has also witnessed a uniform increase of surface ozone of up to 0.25 ppbv/year (HTAP 2010).

According to the WHO report "Tackling Global Clean Air Challenge" South Asia is ranked worst in terms of urban air pollution, along with Iran. The most polluted cities include Lahore (Pakistan) and Ludhiana (India), each with PM_{10} levels above 200 µg. Air pollution has a direct impact on human health. SO_2 also has detrimental effects on human health by contributing to $PM_{2.5}$, on terrestrial and freshwater ecosystems through acidification (Rodhe *et al*. 1995), on man-made materials and cultural heritage by corrosion (Kucera *et al*. 2007), and on biodiversity and forests. Nitrogen compounds have multiple effects on the atmosphere, terrestrial ecosystems, freshwater and marine systems, as well as on human health. Surface ozone also impacts human health. It causes damage to vegetation, reducing crop yields. It is also an important GHG. Ground-level ozone is one of the major contributors to smog. This phenomenon has been particularly noticed in Bangladesh, Bhutan, India and Nepal. The intensity of smog has increased in the Indo-Gangetic plains in the last few years, leading to increased impacts[14].

Outdoor air pollution was estimated to account for approximately 1.4 percent of the total mortality, 0.4 percent of all disability-adjusted life years (DALYs), and two percent of all cardiopulmonary diseases. The map below depicts deaths per 1000 capita due to air pollution.

14 BBC News, 6th January 2012, Pollution Rise 'Worsens' South Asia's Winter Smog by Navin Singh Khadka, Environment Reporter, BBC News

Figure 22: Deaths Attributable to Outdoor Air Pollution (2008)



Source: gamapserver.who.int

Acute respiratory diseases have been recorded by the Department of Public Health (DPH), Maldives and have shown an increasing trend, emerging as one of the leading causes of death. In Bhutan, there were more than a million respiratory disease related referral cases and 436 deaths during the period 2003-2006, due to respiratory problems as per the morbidity reports compiled by the Ministry of Health.

Photo 13: Outdoor Air Pollution is Responsible for Various Health Diseases

Photo Credit: State of Environment Report, Uttar Pradesh

Box 6: Atmospheric Brown Clouds

Atmospheric brown clouds (ABCs) which have been observed as widespread layers of brownish haze, particularly in South Asia, are regional scale plumes of air pollutants consisting mainly of aerosol particles such as black carbon and precursor gases that produce aerosol and ozone. These clouds significantly affect the regional climate, hydrological cycle and glacial melting. The pollutants can be transported by long-range and regional transport phenomenon that push this haze towards the Himalayan ridge, where plain-to-mountain wind systems favour air mass transport to higher altitudes. The widespread nature of ABCs and findings related to their diverse and adverse effects have increased the need for the development of science, capacity and emission-reduction measures within an integrated framework.

Photo 14: Atmospheric Brown Cloud over South Asia

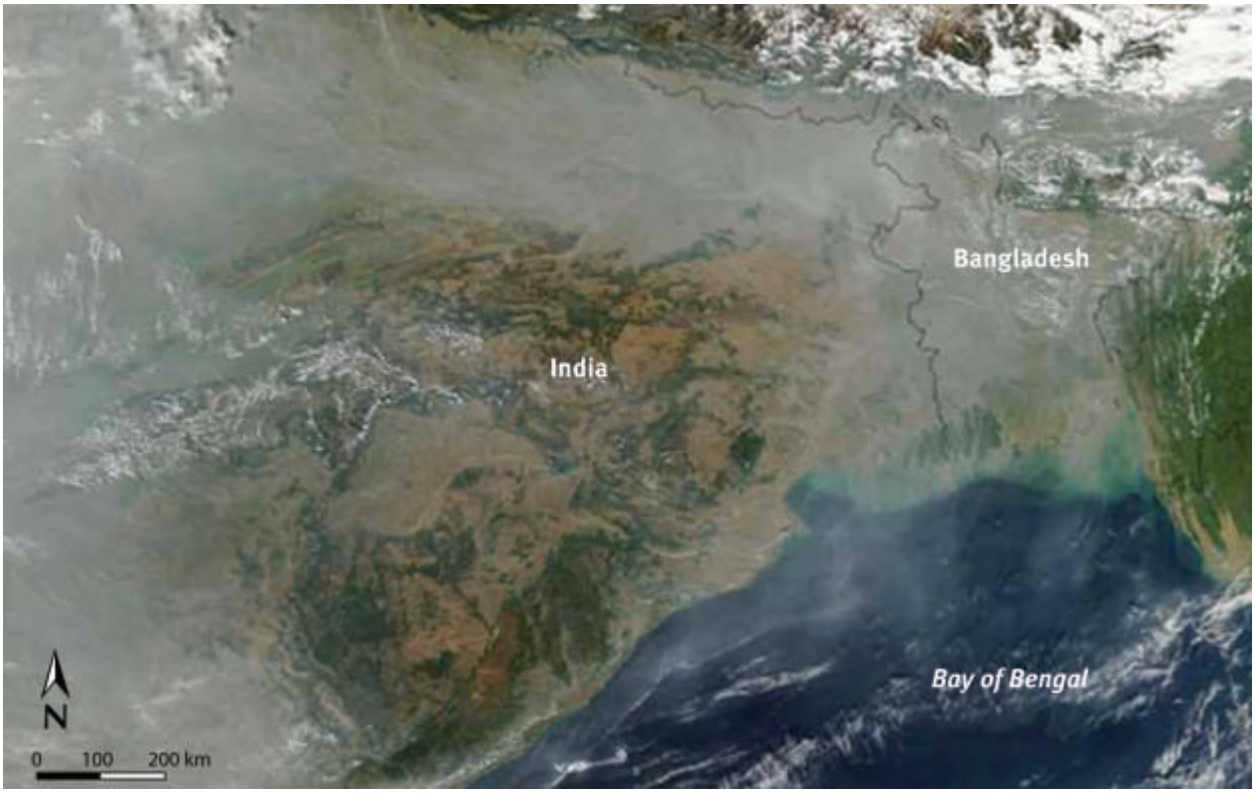


Photo Credit: UNEP (2012)

Box 7: Black Carbon Emissions in South Asia

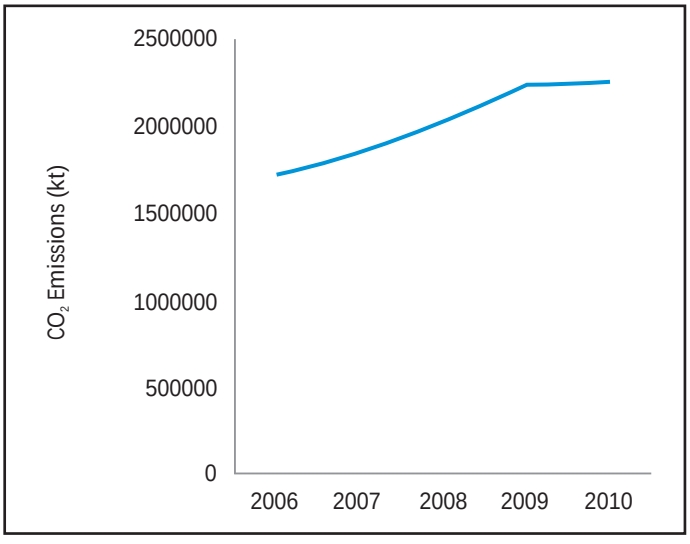
The most important new issue in the study of atmospheric environment is the role of short-lived climate forcers, especially black carbon. Reducing black carbon will slow down the rate of climate change within the first half of this century. Black carbon consists of carbonaceous particles that are emitted to the atmosphere as a by-product of the incomplete combustion of biomass, bio-fuels and fossil fuels. The chemical composition of black carbon depends on its source and can range from partly charred organic plant residues to fine, pure graphitized carbon particles that result from the combustion of carbon containing materials. Asia, including China and India accounts for 40 percent of the entire global black carbon emissions. In South Asia, India ranks highest with 64 percent emissions. Other countries contribute substantially less emissions-Pakistan (22 percent); Bangladesh (8 percent); Nepal (4 percent); Sri Lanka (2 percent) and Bhutan (less than one percent). Biomass burning and fossil fuel and bio-fuel combustion for residential uses are the largest sources of black carbon emissions in South Asia, while non-residential fossil fuel combustion (e.g., for transportation and industrial uses) contributes less to overall black carbon emissions. According to one estimate, fossil fuel, open burning, and residential bio-fuel combustion account for 25 percent, 33 percent, and 42 percent of black carbon emissions in India, respectively.

Source: US EPA (2012)

3.2.3 Greenhouse Gases

Rapid industrialization and increasing energy demands have resulted in a rise in GHG emissions in the region. Major GHGs emitted are CO_2, methane and nitrous oxide. CO_2 accounts for the majority of GHG emissions in the region. The graph below depicts the increment in CO_2 emissions in the region over the years.

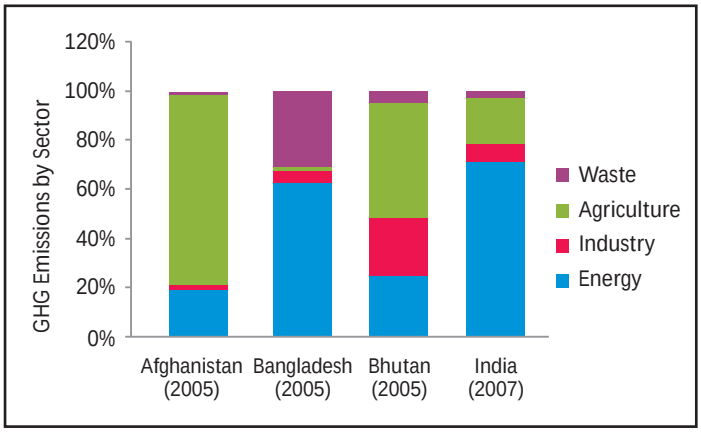
Figure 23: Trends of CO_2 Emissions of South Asia in 2010



Source: World Bank (2010)

India accounts for the highest level of CO_2 emission. The other countries contribute merely 10.82 percent of the emissions. However, the per capita emissions of the region are still far below the world average. A major portion of South Asia's emissions comes from the energy sector, agriculture, industry and waste. Land-use change, forestry and transport also contribute to the GHG profile of the region. The graph below illustrates the major GHG emitting sectors of the region.

Figure 24: High Carbon Emitting Sectors in South Asia, excluding Land-Use Change and Forestry



Source: MoEF (2012), MoEF&CC (2012); NEC (2011); NEPA (2013)

Increase in the concentration of GHG in the atmosphere contributes to climate change, which is one of the most serious threats the planet is facing today. It has wide-ranging impacts on environment and socio-economic sectors.

3.2.4 Indoor Air Pollution

Indoor air pollution is a grave problem in developing countries due to the heavy dependence on solid fuels. Traditional biomass remains a dominant energy source in the region, especially in rural households, mainly due to its low cost and easy accessibility. High dependence on traditional biomass as a source of energy and limited access to commercial and modern fuels is a manifestation of poverty (IEA 2002). In 2005, fuel wood consumption (including fuel wood and charcoal) in the region was 382 million m^3/ year (FAO 2009). In fact, 60 percent of the Indian households still depend on traditional biomass fuels for cooking and heating (MoEF&CC 2011). Biomass like wood, charcoal, agricultural residues and dried animal dung contribute to indoor air pollution due to incomplete combustion, releasing CO_2, SPM, carbon monoxide, formaldehyde, NO_2, ozone and polycyclic aromatic hydrocarbons (PHC) among others.

Photo 15: Firewood for Heating During Winter: A Source of Indoor air Pollution

Photo Credit: K C Ngeydrup

Box 8: Improved Cookstove Activities in Nepal

In Nepal, the Improved Cook Stove (ICS) development and dissemination activities were initiated in early 1950s with the introduction of some Indian models (Hyderabad and Magan stoves). Since then, a number of ICS programmes have been promoted in rural communities of Nepal. During the 1980s, the National Planning Commission included ICS in its development plans. In 1995, the ICS Network supported by Asia Regional Cook-stove Programme (ARECOP) and managed by the Centre for Rural Technology, Nepal (CRT/N) was established, bringing together various organisations working in ICS promotion and dissemination and facilitating further sustainable promotion and dissemination of ICS. The National ICS programme was initiated in 1999 with the support from Energy Sector Assistance Programme (ESAP) of DANIDA and Alternative Energy Promotion Centre (AEPC) of the HMG/N. The programme is implemented through various implementing partners like the Department of Women and Children, CRT/N and other district-level NGOs and CBOs.

Source: Compiled from various sources

The health effects of indoor air pollution can be more severe than those of outdoor air pollution. The impacts depend on the concentration and the characteristics and the level of exposure to the pollutants. According to WHO, indoor smoke can exceed the acceptable levels for small particles hundred-fold in poorly ventilated dwellings. Exposure is particularly high among the women and young children, who spend most of their time near the domestic hearth. Exposure to pollutants also increases the risk of pneumonia and other respiratory infections among children under the age of five and chronic obstructive pulmonary diseases among the adults above 30. Effects of smoke from coal combustion manifests itself in the form of lung cancer (Hu and Ran 2009). It also increases the risk of otitismedia, asthma, tuberculosis, low birth weight, still birth and neonatal mortality. Afghanistan, Bangladesh, India and Pakistan along with Angola, China, the Democratic Republic of Congo, Ethopia, Indonesia and Nigeria, are victims of the indoor air pollution which is responsible for a total of more than 1.5 million deaths per year (WHO 2002). In Pakistan, the total number of deaths per year attributed to this kind of pollution is 280,000. Indoor air pollution is also responsible for 40 million cases of acute respiratory illnesses (World Bank 2006). These figures put Pakistan among the 21 worst affected countries along with Afghanistan, Ethiopia, Nigera and Rwanda, among others (WHO 2002). According to WHO, it is estimated to be responsible for around 4-6 percent of the national burden of diseases in India.

Growing concern for the serious health and environmental impacts of enduring dependence on dirty cooking fuels is also driving efforts to better understand household fuel choices, to set new targets for access to modern fuels, and design policies that facilitate a swifter transition to cleaner fuels and stoves (AGECC 2010; Ekholm *et al.* 2010; IEA, 2011; World Bank, 2011b). The Ministry of New and Renewable Energy (MNRE), Government of India has launched an initiative named the 'National Biomass Cook-stoves Programme' in 2009 with the primary aim to enhance the use of biomass cookstoves. A project entitled "A New Initiative for Improved Cookstoves: Preparatory Activities for Launch" was taken up by MNRE at the Indian Institute of Technology, New Delhi during the year 2009-10 to assess the present status of various types of improved *chulhas* (stoves), their suitability and delivery mechanisms. The Indian Institute of Technology prepared an action plan for development and deployment of cook-stoves. Currently, its recommendations are being acted upon.

Similar efforts were seen in the other countries. Bhutan has implemented improved cook-stove projects. In addition, under the Rapid Rural Electrification Program, more than 85 percent of households have been electrified. Where grid power connection is not feasible, government has supplied solar power. In Pakistan, a fuel efficient cooking technology project funded by GTZ Germany was launched successfully and implemented throughout the country. The Pakistan Council for Renewable Energy Technologies (PCRET) installed 60,000 improved cooking stoves all over the country (Mirza *et al.* 2008). In Sri Lanka, the Improved Cookstoves Programme has been operational since 1970s. The ICS development and dissemination activities were initiated in Nepal in the early 1950s with the introduction of some Indian models: Hyderabad and Magan stoves. Since then, a number of Improved Cookstove Programmes (ICSPs) have been promoted in the rural communities of Nepal.

3.2.5 Initiatives to Tackle Outdoor Air Pollution

To mitigate air pollution, countries are taking different measures. The National Environment Commission of Bhutan introduced the vehicular emission standards and made vehicular emission testing mandatory in 2004.

Industrial emission and discharge standards have also been set. The environmental unit of the Ministry of Economic Affairs has been delegated with the responsibility of facilitating and monitoring the implementation of standards. In addition, daily monitoring is carried out at eight stations covering urban, rural and industrial areas. The Central Pollution Control Board (CPCB), India is executing a nation-wide National Air Quality Monitoring Programme (NAMP). NAMP is being carried out with the help of CPCB, zonal offices, state pollution control boards, pollution control committees and the National Environmental Engineering Research Institute (NEERI), Nagpur. 560 ambient air quality stations are operational covering 223 cities, towns and industrial areas in 26 states and five Union Territories. MoEF&CC in association with the CPCB and the State Pollution Control Boards (SPCBs) of Gujarat, Maharashtra and Tamilnadu, has initiated a large-scale pilot programme to design a particulate emissions trading regulatory regime for industry. Apart from the ambient air quality pollutants, CPCB is also monitoring hazardous organic compounds Dioxin-Furan in stationary source emission at Incinerators of Treatment Storage and Disposal Facilities (TSDFs), incinerators of organic chemical manufacturing units and bio-medical waste incinerators.

Sri Lanka has published new regulations relating to the requirement of gas emission tests in 2008 in order to curtail the emission of noxious gases. Interim emission standards for industries have also been drafted. The Ministry of Environment, Sri Lanka has also developed a National Policy on Air Quality Management. Apart from this, a plan for vehicle emission control has also been developed.

Photo 16: Emissions Monitoring

Photo Credit: Annual Report 2012-13, Ministry of Environment and Forests, India

In order to reduce GHG emissions, the Afghan government announced afforestation plans in Kabul city. Under the 'Declaration of the Kingdom - The Land of Gross National Happiness to Save Our Planet', the Government of Bhutan is committed to the country's status as a net sink for GHG and remain carbon neutral. India has set a target of reducing the emission intensity by 20-25 percent by 2020 in comparison with the 2005 level. This will be achieved through a multi-sector sustainable development strategy through the 12th Five Year Plan. India has a well-developed policy and legislative regime for promoting energy efficiency, renewable energy, nuclear power, fuel switching, and energy pricing reform to address the GHG emissions. In early 2009, the Government of Maldives announced plans to make the island nation nearly carbon neutral within the coming decade. The Haritha Lanka Programme of Sri Lanka recommends a number of measures like introducing bio-fuels in the transport sector, improving the efficiency of industrial and energy sectors and enhancing the forest area to reduce the emissions.

3.2.6 Trans-boundary Air Pollution

"Malé Declaration on Control and Prevention of Air Pollution and its likely Trans-boundary Effects for South Asia", adopted in the Seventh Meeting of the Governing Council of SACEP is a landmark initiative strengthening regional cooperation to address air pollution issues in the region. The participating countries are Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka. It stated the need for countries to carry forward, or initiate, studies and programmes on air pollution. Besides laying down the general principles of inter-governmental cooperation for air pollution abatement, the Declaration also sets up an institutional framework linking scientific research and policy formulation. It also makes provision for cooperation among the key stakeholders in tackling the trans-boundary air pollution in South Asia. The implementation has been done in a phase-wise manner:

- Phase I: Preparatory Phase (1999-2001)
- Phase II: Capacity Development (2001-2004)
- Phase III: Monitoring (2005-2008)
- Phase IV: Regional Cooperation (Ongoing)

Phase IV aims to strengthen regional cooperation and stakeholder participation and enhance the capacities of nations on emission inventory development and integrated assessment modelling. It would also provide the decision support information for policy formulation and air pollution

prevention and raise awareness by networking with youths and national level awareness programmes like TV shows, drama, posters and workshops.

3.2.7 Conclusion

Urbanization and industrialization are the two major reasons for the deteriorating ambient air quality in the region. Particulate matter is a matter of concern as high concentration of PM has been recorded in various cities in Afghanistan, Bangladesh, India and Pakistan. The decreasing trends of sulphur-dioxide illustrate the effectiveness of the mitigation measures. Black carbon emissions are an emerging issue in the study of atmospheric environment. Asia, including China and India accounts for 40 percent of the global black carbon emissions. It is necessary to reduce the emissions to slow down the rate of climate change. The emissions of GHG have increased steadily in the region. Most of South Asia's emissions comes from the energy sector, agriculture, land use, and forestry. Industry, transport and agriculture waste also contribute to the GHG profile of the region. It is urgent for all the countries to shift to a low carbon development pathway to mitigate the effects of climate change. Indoor air pollution is also a matter of grave concern due to use of solid fuels. However, various efforts like the introduction of improved cookstoves are being undertaken in the region to improve the quality of indoor air.

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3.3 Water

A small amount of the water on Earth is available for human use. About two-third of the freshwater is locked in glaciers, ice caps and permafrost. And, around one-third is groundwater. The remaining freshwater is found as surface water in rivers, lakes and swamps. One key characteristics of freshwater is its uneven distribution throughout the world. Of the global water resources, a large fraction is available in regions where the human demands are less, like the Amazon basin and Alaska. Although South Asia is home to about one-fourth of the world's population, it only contains about 4.5 per cent (1,945 billion m^3) of the world's annual renewable water resources (43,659 billion m^3). Given the large population of the region and its economic growth, the water withdrawals are also high. In fact, the water demand exceeds the supply in many parts of the region.

Water in the region is not simply confined to its political borders. Most of the major rivers flow through more than one country. The Ganges-Brahmaputra-Meghna and the Indus basins are the major river systems of the region, spread over Bangladesh, Bhutan, China, India and Nepal. This can certainly become a major avenue for cooperation in the region.

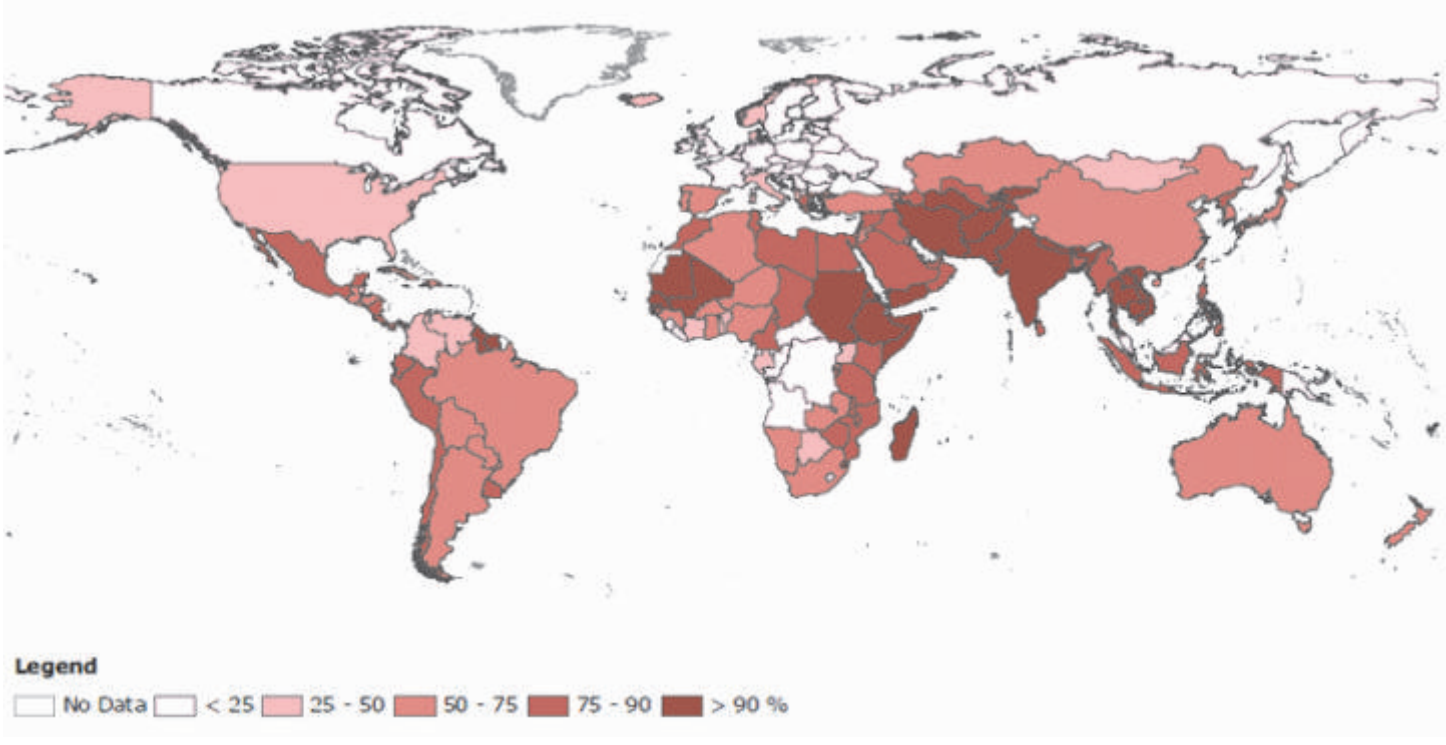
3.3.1 Issues and Pressures

The consumption of water in the region is driven by a few major sectors like agriculture, industry, energy, and human settlements. The agriculture sector has a large water footprint in comparison to the other sectors. This holds especially true for South Asia which is an agrarian region, as illustrated by the map below, and where water is withdrawn for irrigation, livestock and aquaculture purposes.

Water withdrawal for irrigation is a part of agricultural water withdrawal. Irrigated agriculture accounts for about 70 percent of freshwater withdrawals throughout the world (FAO 2013). Irrigation water withdrawal largely exceeds its requirement due to the losses during distribution from its source to the crops.

In comparison to the agricultural sector, industrial and municipal sectors have a low water footprint. Maldives is an exception where major portion of water is used by the municipal sector.

Figure 25: Proportion of Total Water Withdrawal for Agriculture (around 2006)



Source: FAO (2013)

Glacial Melt

The impacts of climate change are manifested in the global and regional hydrological cycles. These impacts can be witnessed in the form of changing precipitation patterns, increase in the number and intensity of extreme events, and retreating glaciers among others.

The Himalayas are termed 'Water Towers of Asia' as they are the source of nine of the largest rivers. Himalayan glacial snowfields store about 12,000 km^2 of freshwater. About 15,000 glaciers are present in the Himalayas and support perennial rivers such as Indus, Ganges and Brahmaputra.

Most glaciers in the Himalayas are relatively small and quite vulnerable to global warming. These glaciers are retreating faster than almost all the glaciers in the world. Various reasons can be attributed to this phenomenon like human-induced CO_2 emissions and growing levels of short-lived aerosols in the air, snow and on glaciers. However, more scientific evidence is needed to convincingly conclude that climate change is responsible for the abnormal glacier retreat in the region. Glacial melt will have a significant impact on the lives of communities in the region due to its negative impact on water storage and yield.

The Ministry of Environment, Forests and Climate Change, Government of India and Indian Space Research Organization (ISRO) undertook a study to monitor more than 2000 glaciers for their advance/ retreat over a period of 15 years. According to it, 76 percent of glaciers have shown retreat, seven percent have advanced while 17 percent have remained static. According to another study '*Himalayan Glaciers: A State-of-Art Review of Glacial Studies, Glacial Retreat and Climate Change*', glaciers in the region have behaved in contrasting ways over the last 100 years. Siachen glacier is believed to have shown an advance of about 700 m between 1862 and 1909, followed by an equally rapid retreat of about 400 m between 1929 and 1958, and hardly any retreat during the last 50 years. A declining trend can be seen in the degeneration of glacial mass from north-west to north-east with degeneration being the highest in Jammu and Kashmir and lowest in Sikkim (MoEF & CC 2012).

There are a total of 677 glaciers present in the Bhutan Himalayas, covering an area of 1,317 km^2. A total of 127 km^3 of ice reserves can be found in the region. Of the six types of glaciers in the Bhutan Himalayas, mountain glaciers are the most common ones (ICIMOD and UNEP 2002; UNDP/EU 2008). Debris covered glaciers in the country have been retreating at the rate of 30-40 m per year. On the other hand, debris- free glaciers have been retreating at the rate of 8-10 m per year (NEC 2011). Frequent droughts and increasing air temperatures have reduced the size of glaciers in Afghanistan as well. Large glaciers in the Pamir and the Hindu Kush mountains have shrunk by 50 percent in the last 50 years (NEPA 2008).

A total of 3,808 glaciers were found in Nepal in 2010. A decrease of 24 percent in the total glacier area has been observed between 1977 and 2010. However, the number of glaciers has increased by 11 percent. This can be attributed to the fragmentation of glaciers after their shrinkage (Bajracharya *et al*. 2014).

Countries are threatened by glacial melt due to the diminishing water flows. Taking into account the impacts of glacial melt on the country and the fragility of the Himalayan ecosystem, the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) has been included as one of the eight missions under the National Action Plan on Climate Change of India. The main objective of this area-specific mission isto conserve the Himalayan glaciers and its ecosystem. It encourages trans-boundary exchange of information through mutually agreed mechanisms.

Photo 17: Glaciers in the Himalayan Region of Nepal

Photo Credit: Paribesh Pradhan, ICIMOD

Impact of Agriculture on Water Quality

The application of fertilizers and pesticides has increased in the region to maintain and improve crop yields by controlling weeds, pests, fungi etc. This is illustrated through the consumption figures of various countries. The fertilizer consumption in India increased from 2.6 million tonnes in 1970-71 to 24.91 million tonnes in 2008-09

(MoEF&CC 2012). Even though the use of pesticides in Bhutan is moderate, its overall pesticide usage has increased over the years. It has increased by nearly 39 percent between 2006-07 and 2010-11. According to FAOSTAT, the total nitrogen and phosphate fertilizer usage on arable and permanent crop area increased in Bhutan, India, Nepal and Pakistan during the period 2006-2010. The increase in the use of pesticides and fertilizers has contributed to the pollution of both surface and ground water. These fertilizers and pesticides enter the water bodies through run-offs and leaching into the groundwater, polluting the water and posing hazards to humans and other organisms. The sugarcane industry in Pakistan is the largest contributor to industrial water pollution.

3.3.2 State of Water Resources

The distribution of freshwater supplies varies from one country to another due to the uneven rainfall. The average Total Actual Renewable Water Resources (TARWR) available to each country provides a snapshot of this geographical variability. TARWR is the sum of the internal renewable water resources and the incoming flow originating outside the country. It is a measure of the maximum theoretical amount of water actually available for the country. However, TARWR per person is a more suitable indicator for water availability for various purposes. According to Millennium Development Goals (MDGs) indicators, TARWR per capita has been steadily decreasing in the region.

Table 11: TARWR per Capita of South Asia (m^3/inhab/year)

	1992	2002	2012
Afghanistan	4,222	2,651	1,956
Bangladesh	11,132	9,139	8,051
Bhutan	173,993	133,663	104,000
India	2,100	1,755	1,519
Maldives	129.3	106.4	92.59
Nepal	10,487	8,223	6,778
Pakistan	2,091	1,641	1,371
Sri Lanka	2,976	2,759	2,488

Source: FAO-AQUASTAT Database

Groundwater is a significant resource for human consumption. It is under increasing stress due to various anthropogenic factors. Globally, groundwater extraction is driven by population growth and the associated increase in demand for water. As of 2010, the world's aggregated groundwater extraction is estimated at approximately 1,000 km^3 per year, about 67 percent of which is used for irrigation, 22 percent for domestic purposes, and 11 percent for industrial purposes. Asia accounts for 68 percent of groundwater extraction in the entire world. India, Pakistan and Bangladesh are some of the major consumers of groundwater. In fact, depletion of groundwater would is bound to profound impacts on human welfare and ecosystems.

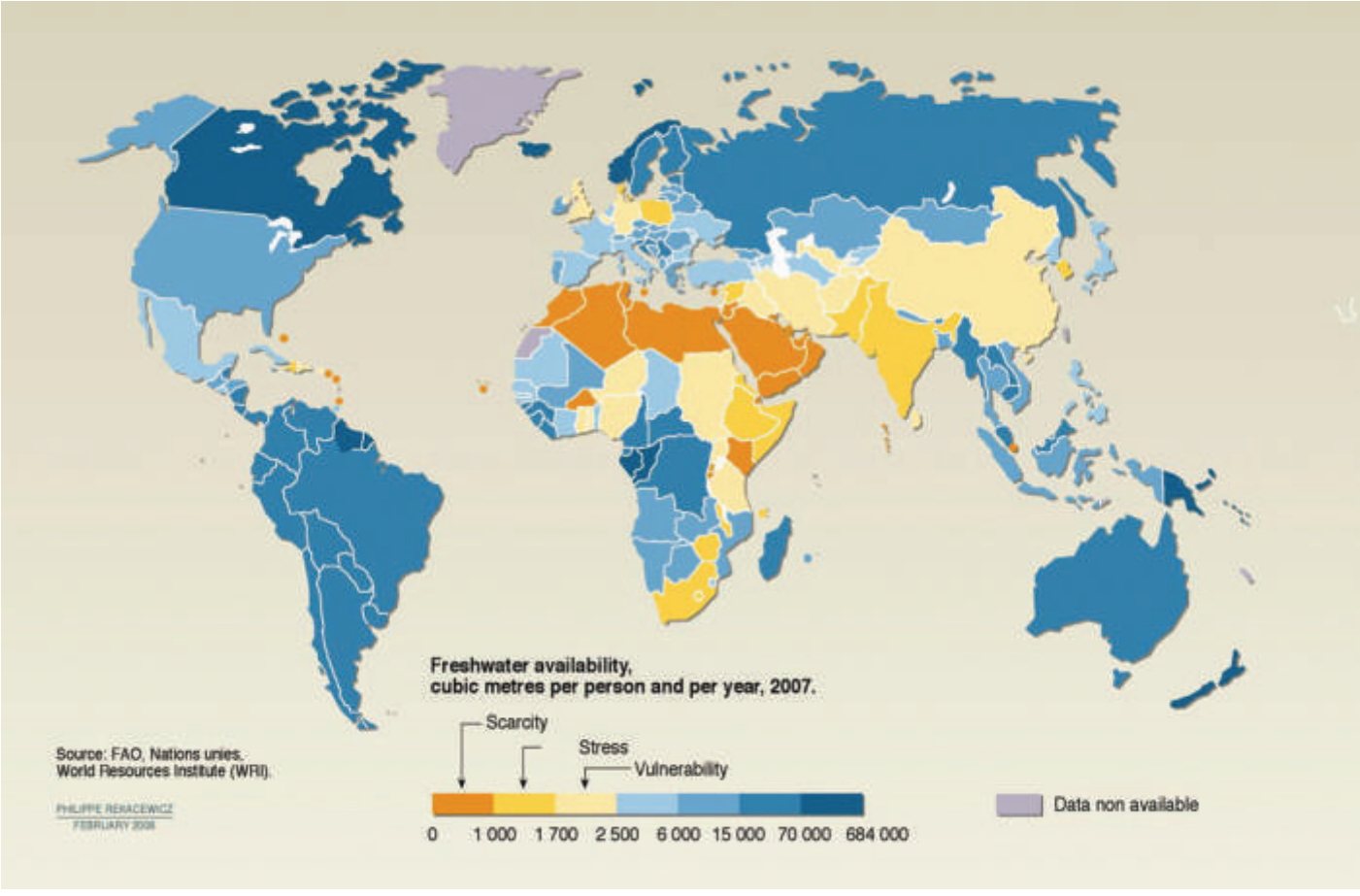
Table 12: Top 10 Groundwater Extracting Countries as of 2010

Country	Abstraction (km^3/year)
India	251
China	112
USA	112
Pakistan	64
Iran	60
Bangladesh	35
Mexico	29
Saudi Arabia	23
Indonesia	14
Italy	14

Source: UNESCO (2012)

Water scarcity is a significant and ever increasing threat to the environment, human health, development, energy security and the global food supply. An area experiences water stress when its annual water supplies drop below 1,700 m^3 per person. When the annual water supplies drop below 1,000 m^3 per person, the population faces water scarcity, and "absolute scarcity" below 500 m^3. Except for Bhutan and Nepal, the per capita water availability in the region is less than the world average. Pakistan depends entirely on a single river system - Indus. Although, in addition to the Indus River System, the Kharan Closed Desert Basin and the Mekran Coastal Basin located in Baluchistan has some development potential but it constitutes less than three percent of the total surface water. In fact, 105 MAF out of the total 145 MAF in the Indus basin is already being used through 19 barrages with 45 canal systems (FBS 2010).

Figure 26: Freshwater Availability in 2007 (cubic metres/person/year)



Source: UNEP/Grid Arendal (2008)

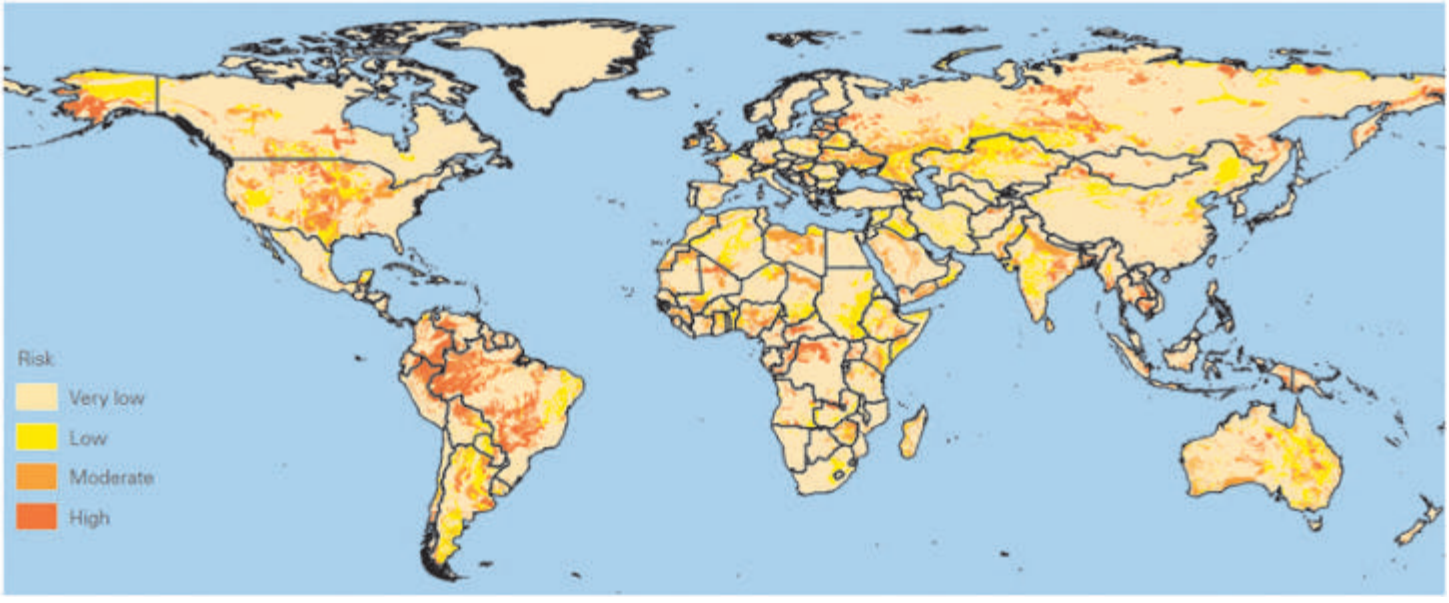
The per capita availability of water in Bhutan is one of the highest in the world. The per capita mean annual flow availability is estimated to be 100,000 m^3. However, localized water shortages occur in several places due to the growing human population, difficult terrain constraining tapping of water sources, and poor maintenance of water storage and distribution facilities. Currently, 11 towns face a water constraint. It is predicted that seven more towns will face a water constraint by 2013 (NEC 2008).

3.3.3 Groundwater Contamination

Groundwater in the region is threatened by pollution from agricultural and urban areas, solid waste, and industrial effluent along with other contaminants. Arsenic contamination in groundwater has been observed in the Ganga-Brahmaputra fluvial plains in India, Padma-Meghna fluvial plains in Bangladesh and the north-central part of Sri Lanka. West Bengal, Bihar, Jharkhand, Uttar Pradesh, Chhattisgarh, Assam and Manipur in India are also severely affected by arsenic contamination. Bangladesh is the worst affected country, with some 35 million people drinking groundwater containing arsenic at concentrations greater than 50µg/L and around 57 millions drinking water with concentrations greater than 10 µg/L. More than five million people in West Bengal are drinking water with arsenic concentrations greater than 50 µg/L (World Bank 2005). These concentrations are greater than the WHO guideline of 10 µg/L. The scale of arsenic contamination in Pakistan appears to be relatively small. The Provincial Government of Punjab, together with UNICEF, began an arsenic testing programme in northern Punjab in 2000. A total of 364 samples were analyzed. The majority (90 percent) of samples had arsenic concentrations less than 1µg/L, although six samples (two percent) had concentrations above 50 µg/L (Iqbal 2001). The following map depicts the high risk areas of arsenic contamination.

The groundwater in most of the islands in Maldives is contaminated and not suited for drinking. The use of septic tanks and primitive sewarage systems are some of the

Figure 27: Estimated Risks for Arsenic Contamination Based on Hydro-Geological Conditions



Source: Schwarzenbach et al. (2010)

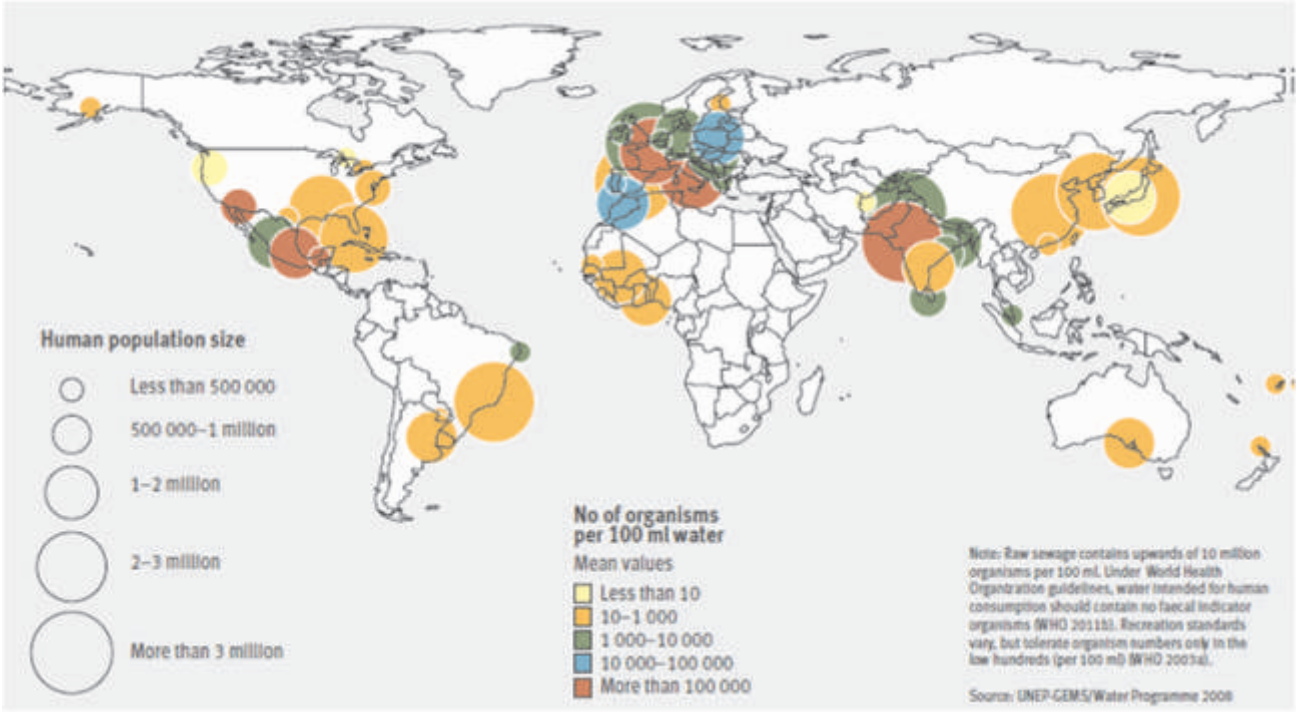
major causes of the deteriorating groundwater quality (Ministry of Environment and Energy 2011). Statistics reveal that arsenic, iron and fluoride have affected the groundwater in over 200 districts in India.

The government of Bangladesh formulated the National Policy on Arsenic Mitigation in 2004. Based on this, an Implementation Plan on Arsenic Mitigation (IPAM) was drafted. Later on, an Arsenic Policy Support Unit (APSU) and a National Committee was established for IPAM. The problem of groundwater contamination with arsenic has been accorded top priority by the Government of West Bengal in India. An Arsenic Task Force was constituted to develop a mitigation plan. The mitigation plan was prepared for the entire state to provide arsenic free water to the arsenic affected villages using surface water and groundwater based schemes with the provision of Arsenic Treatment Unit. Arsenic removal plants have been installed at various places throughout the state. The Government of Bihar has also taken steps to mitigate arsenic contamination in groundwater by installing filters at the community level.

Pathogenic Contamination

Globally, the presence of microbial pathogens is the most pressing water quality issue in many developing countries. Pathogenic contamination of surface and groundwater in South Asia poses critical threat to human health. The major sources of pathogens are human and animal faeces and domestic sewage. Microbial pathogens in water include viruses, bacteria and protozoa. The presence of Coliform bacteria is an indicator of bacterial contamination in water. The map on the next page (Figure 28) depicts a concentration of 100,000 Coliform per 100 ml of water in many areas of India and Pakistan. Bacteriological contamination in drinking water is pretty common in Pakistan (PCRWR 2005). Water bodies like rivers, lakes and ground aquifers in most of the regions of the country are highly polluted with bacteriological contamination (Aziz 2005). In the Gilgit district of the country, water quality was analyzed in 2005-06. All the samples collected from different locations tested positive for bacterial contamination (FBS 2010). The total Coliform counts in the water samples collected from various points along the Punatsangchhu in Bhutan were beyond the acceptable limit of 50 per 100 ml for Grade 'A' water quality. Similarly, the total Coliform count of river Ganga in India was found to be $5\text{-}25X10^5$ (MPN/100 ml) (MOSPI 2014).

Figure 28: Faecal Coliform Concentrations in Rivers near Major Cities (1990-2011)



Source: UNEP-GEMS/Water Programme (2008)

River Water Pollution

The quality of water in the region has been an issue of increasing concern in the recent times. Rapid population growth, urbanization and the ever increasing demand in terms of water for agriculture, industry and domestic purposes have severely deteriorated the water quality. In Afghanistan, water bodies are polluted due to the disposal of untreated industrial and domestic effluents, along with household and street waste in streams.

The second largest watershed of Sri Lanka, the Kelani River, is the most polluted river of the country. The Central Pollution Control Board of India analyzed water quality data during 2002-2008 and identified 150 polluted river stretches in the country. The population of Bangladesh depends upon the 230 small and large rivers flowing in the country. Major rivers like the Buriganga, Shitalakhya, Turag and Balu are heavily polluted and receive 1.5 million cubic metres of waste water every day from the industrial units[15]. The quality of rivers and their tributaries in Bhutan is pristine. Localized pollution problems can be witnessed in the country due to unsanitary conditions along banks of streams and rivers. This problem is exacerbated in urban centres, especially Thimpu and Phuentsholing, where surface drainage, grey water sullage from domestic households and uncontrolled seepage or overflow from septic tanks and pipes enter into the water courses (NEC 2008).

Photo 18: Pristine Water Quality of Bhutan

Photo Credit: NEC, Bhutan

15 http://www.reuters.com/article/2009/05/19/us-Bangladesh-rivers-id USTRES 2104 G20090519

Photo 19: Polluted Rivers in Afghanistan

Photo Credit: NEPA, Afghanistan

Table 13: Water Quality in Indian Rivers in 2011

Name of the River	Temperature (°C)	pH	DO (mg/l)	BOD (mg/l)
Ganga	3-37	6.7-9.1	4.0-14.3	0.2-11
Yamuna	4-38	6.9-8.8	0-17	0.2-41
Godavari	18-40	6.4-9.1	1.2-12.2	0-37
Krishna	19.2-38	6.4-8.7	1.7-15.8	0.4-16
Cauvery	20-34	4.3-8.9	1.7-10.9	0.1-7.2

Source: MOSPI (2014)

3.3.5 Policy Responses in the Region

The Government of Afghanistan has made the development of the water sector as one of its top priorities. The major policy that guides the water sector in Afghanistan is the Strategic Policy Framework for the Water Sector, which was approved by the Supreme Council for Water Affairs Management (SCWAM) in November 2006. It described the way forward for the water sector and suggested changes in the Water Law as well as formulation of various policies like regulations for both surface and ground water resources, irrigation policy and regulations, national urban and rural water supply and sanitation policy, and groundwater and hydropower development policy. All these policies were later approved by the SCWAM as national policies. The draft Afghan Law of 2008 focuses on stakeholder' participation in water management, equitable water allocation, and division of tasks at national, basin and sub-basin levels, including participation of all stakeholders in the decision-making process. Integrated Water Resource Management (IWRM) is being carried out through the river basin approach. Its main aim is to decentralize activities from the central government to the river basin and sub-basin levels and manage efficient resources for socio-economic development, environmental protection and sustainable development. Other major programmes of the Government of Afghanistan include the Irrigation Rehabilitation Programme, the National Water Resources Development Programme, and the River Bank Protection Programme.

Bhutan enacted its Water Act in 2011 and is drafting its regulation. The National Environment Commission is the apex body for coordination of regulations related to water resources in Bhutan. The 'Bhutan Water Vision' and 'Bhutan Water Policy' were published in 2005. The water policy of Bhutan emphasizes water resources management within river basins and aquifers, including both upstream and downstream water users. The focus of the policy is on maintaining the water quality as well as the water quantity. Trans-boundary water issues shall be dealt in accordance with International laws and conventions to which Bhutan is a signatory. Policy and legislations related to water in Bangladesh include the National Water Policy 1999, the National Water Management Plan, Water Resources Planning Act and Coastal Zone Policy 2005. Bangladesh has also drafted its Water Act in 2012.

The Water (Prevention and Control of Pollution) Act was enacted in 1974 in India to provide for the prevention and control of water pollution, and for maintaining the wholesomeness of water in the country. The CPCB has launched the National Water Quality Monitoring Programme in collaboration with the SPCBs. It comprises 1,019 stations in 27 states and six union territories. The monitoring network covers 200 rivers, 60 lakes, 5 tanks, 3 ponds, 3 creeks, 13 canals, 17 drains and 321 Wells. The CPCB is also monitoring the compliance of effluent discharge standards observed by the industries. It has identified the Grossly Polluting Industries which are discharging a BOD load of 100 kg per day or more in the Ganga basin. Recently, the revised guidelines on the

Common Effluent Treatment Plant (CETP) have been approved by the MoEF&CC and the Planning Commission, Government of India. The National River Conservation Directorate is implementing the River and Lake Action Plans under the National River Conservation Plan and the National Lake Conservation Plan by providing financial assistance to state governments. The National Ganga River Basin Authority (NGRBA) was set up in 2009, with the objective of ensuring effective abatement of pollution and conservation of River Ganga. The river-basin approach was used for comprehensive planning and management. The Central Wetlands Regulatory Authority and an Expert Group on Wetlands have been constituted under the National Wetland Conservation Programme. MoEF&CC has signed a Memorandum of Agreement (MoA), with a consortium of seven IITs, for the development of Ganga River Basin Management (GRBMP).

Nepal's policies and regulations related to this sector include the Water Tax Act (2023), Water Resources Act (2049), Nepal Water Supply Corporation Act (2046), Drinking Water Revenue Commission Act (2063), Drinking Water Rules (2055), Drinking Water Revenue Rule (2050) and Water Resource Rule (2050).

The Environment Protection Act of Pakistan (1997) provides the overarching framework for the development of policies for all the major sectors in the country. The major legislations dealing with water quality and resource management include the Canal and Drainage Act (1873), the Factories Act (1974), the Baluchistan Ground Water Rights Administration Ordinance (1978), the Baluchistan, Khyber Pakhtunkhwa (KP), Punjab and Sindh Local Government Ordinance-(s) (1979/80), On-Farm Water Management and Water Users' Associations Ordinance (1981) and the Indus River Water Apportionment Accord (1991). The Punjab Soil Reclamation Act (1952) deals with the preparation and implementation of schemes concerned with the control of water-logging and salinity. The National Water Policy (2012) focuses on issues like irrigation, municipal, rural water supply and sanitation, water use for industry, hydropower, water rights and allocation, groundwater, flood and drought management, drainage and reclamation, water quality, wetlands, ecology and recreation and trans-boundary water sharing. Apart from this, the government has also drafted the National Drinking Water Policy (2009) and National Sanitation Policy (2006). Sri Lanka does not have a formal Water Act as of now. However, it does have a National Policy on Drinking Water.

Regional Initiatives

To address the issue of trans-boundary water quality, the Cooperative Monitoring Center (CMC), USA with complementary funding from the US Department of Energy, initiated the South Asian Water Analysis Network (SAWAN). Bangladesh, India, Nepal and Pakistan are participating in this programme to monitor the trans-boundary river water quality of the Ganga Basin in South Asian. The main objective of this programme is to promote co-operation in South Asia on environmental research, share regional information to build confidence, expand future co-operation, as well as collect and share water quality information pertaining to a number of rivers throughout the region. The immediate interest of the programme is to collect and share water quality information among partner countries in order to understand the quality of the rivers. ICIMOD will house the website and database and work in collaboration with CMC to continue to implement the programme[16].

The South Asia Water Governance Programme (SAWGP) aims to increase the regional cooperation in the management of Himalayan rivers to address the challenges of development and climate change. It brings together a broad set of stakeholders from different disciplines to identify, frame and resolve the challenges on these trans-boundary waters at regional and national levels. The focus will be on the three river basins-Ganga, Indus and Brahmaputra. The ideas emerging from the river basins will be tested in two landscapes, one upstream at the source of the rivers (Mount Kailash), and one downstream at the mouth of two rivers (Sundarbans).

3.3.6 Conclusion

The per capita availability of water has decreased in the region due to the increasing population and rampant water withdrawals. Glacial melt is compounding the stress in the region. Countries like Bhutan, India, Nepal and Pakistan are threatened by the diminishing water flows. Apart from the water scarcity, water pollution is also a major issue. The river quality has degraded due to industrialization. In the same vein, groundwater contamination also needs to be addressed.

16 http://icimod.org/

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3.4 Biodiversity

South Asia is rich in biological diversity. In rural areas of the region, people depend on biological resources for as much as 90 percent of their needs, including food, fuel, medicine, shelter and transportation. There is growing evidence that biological diversity has a vital role in attaining the Millennium Development Goals: it contributes to poverty reduction and sustenance of human livelihoods and well-being through, for example, underpinning food security and human health, providing clean air and water, and supporting economic development (MA 2005).

Biodiversity is formally defined by the Convention on Biological Diversity (CBD) as: "the variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (UN 1992 Article 2).

Even though the importance of biodiversity conservation is being recognized, biodiversity loss in terms of ecosystems, species and genes continues. Reducing the rate at which biodiversity is being lost is a priority issue for South Asian countries all of whom are parties to the Convention on Biological Diversity and are working towards the achievement of the Aichi Biodiversity Targets.

Among the drivers, population growth and economic expansion are greatly responsible for unsustainable extraction of natural resources. Poverty and high dependence on natural resources, combined with inadequate policy measures, have lowered resource productivity. They have also increased the rate at which natural resources are being exploited. Other reasons for biodiversity loss include enhanced levels of pollution, poaching, climate change and the spread of invasive and other problematic species.

3.4.1 Biological Wealth of South Asia

The vast geography of South Asia hosts a diverse range of ecosystems. These include the mountains of the Hindu-Kush-Himalayas, the Thar Desert, The Sundarbans and the coral reefs and atolls of Maldives.

The region is home to four global biodiversity hotspots:

- The Western Ghats and Sri Lanka;
- The Eastern Himalayas;
- Indo-Burma, which is now more narrowly redefined as the Indo-Chinese sub- region and
- Sundaland

Box 9: Rare Dolphins in the Sunderbans

Nearly 6,000 Irrawaddy Dolphins, which are related to Orcas or killer whales, have been found living in the freshwater regions of the Sunderbans mangrove forests and the adjacent waters of Bay of Bengal. The Irrawaddy Dolphin grows up to 8 feet (2.5 metres) in length and frequents large rivers, estuaries, and freshwater lagoons in South and Southeast Asia. In 2008, they were listed as vulnerable in the International Union of Conservation of Nature's Red List based on declines in known populations. However, these dolphins are threatened by climate change and fishing nets.

Source: MoEF (2010)

Forest Ecosystem

Forests in the region range from montane, tropical rainforests, sub-tropical forests to coastal and temperate forests. These forest ecosystems provide a rich habitat to a variety of flora and fauna.

According to Afghanistan's Fourth National Communication to CBD, 2010, the country's landscape, being majorly alpine, desert and open woodland, has limited evergreen forests and woodlands which cover about eight percent of its area. Mixed conifers and broad-leaf forests are the common forest types in Bhutan. Tropical evergreen and semi-evergreen forests of Bangladesh harbour numerous floral and faunal species; an estimated 2,259 species of angiosperm were reported in the Chittagong region alone.

Sri Lanka's distinct climate zones are characterized by varied forest types like rainforests, montane cloud forests, dry zone monsoon forests and arid thorn scrub forests. Bengal tiger *(P. tigris)*, snow leopard *(Uncia uncia)*, sloth bear *(Melursus ursinus)*, rhino *(Rhinoceros unicornis)*, asian elephant *(Elephas maximus)*, red panda *(Alilurus fulgens)* frequent the South Asian forests along with other vulnerable species of birds, reptiles and amphibians. Critically endangered species like pygmy hog *(Sus salvania)*, white-rumped vulture *(Gyps bengalensis)*, white-bellied heron *(Ardea insignis)* and endangered species like Himalayan Musk Deer *(Moschus chrysogaste)* also dwell in the forests of South Asia.

About 14 percent of the world's remaining mangrove habitation is found in South Asia - with the Sunderbans of Bangladesh and India being the largest contiguous mangrove forest in the world. A total of 334 species of trees, shrubs, herbs and epiphytes and 400 species of wild animals are found in the Sunderban region of Bangladesh (Department of Environment 2010).

About 4,663 km^2 of area in India is under mangrove vegetation. An increase of 4,419 km^2 has been witnessed in the time period 1991-2011 (MOSPI 2014). Mangroves and swamps are found in the southern atolls of Maldives, harbouring about 13 species. In all, 6,080 hectares of mangroves are found in Sri Lanka. Eight mangrove species are reported along the coast of Pakistan. *Avicennia marina* is the most dominant species.

Photo 20: Mangroves-Home to a Plethora of Species

Credit: WWF-India

Coastal and Marine Biodiversity

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 and Magna have contributed to large networks of backwaters, estuaries, salt marshes and mangroves. The coastal belt of India, Sri Lanka and Bangladesh are rich in biodiversity including mangroves. South Asia 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, including atolls along the Lakshadweep-Maldives-Chagos ridge, fringing and patch reefs in Andaman and Nicobar Islands, near Gulf of Mannar in India and Sri Lanka and along the south-western and eastern coastline of Sri Lanka. Coral reefs have also been identified in Bangladesh and along the Baluchistan coast in Pakistan.

Maldives is rich in marine biodiversity, with a total of 1,100 species of demersal and epipelagic fish including sharks, five types of marine turtles, 21 species of whales and dolphins, 187 species of corals and 400 species of molluscs. There are 120 species of copepods, 15 species of amphipods, over 145 species of crabs and 48 species of shrimps. Ecosystems such as sea grass beds, mangroves and swamps are also found here. The coral reefs of Maldives are among the richest in the world in terms of species diversity. The reef slopes are covered with lush coral vegetation. The economy of Maldives is heavily dependent on its marine biodiversity (Ministry of Housing and Environment 2010). Sri Lanka is also well-known for its coral biodiversity. Three types of distinct reefs have been identified around the island: coral, sandstone, and rocky reefs. These occur either separately or mixed together. Fringing coral reefs are found along two percent of the coastline. The most extensive coral reefs in Sri Lankan waters are the patchy coral reefs in the northwestern coastal and offshore waters, occurring within the Gulf of Mannar and west of the Kalpitiya Peninsula. Species of spiny lobsters and other invertebrates, sea turtles and dolphins and coral reef fish are also associated with coral reefs of the country. Sri Lanka also has extensive sea grass beds. Around 12 species of sea grass have been recorded so far (Dela 2009).

Photo 21: Coral Reefs of Maldives

Photo Credit: Ahmed Shan

The richness of the marine diversity of Pakistan is exemplified by the fact that almost 800 marine fish species have been recorded. Pelagic fish like tuna are common near Baluchistan. The green turtle *(Cheloniamydas)* and the olive ridley turtle *(Lepidochelysolivacea)* are also found in Pakistan. Squids and oysters are also found in abundance.

India also has a wide range of marine biodiversity like marine algae, sponges and hard corals, crustaceans and many others. Major coral reef ecosystems are Gulf of Mannar, Gulf of Kachchh, Andaman and Nicobar and Lakshadweep Islands. The total area of coral reefs in India has been estimated as 2,383 km^2 (MoEF&CC 2014). Corals have recently been discovered along the coast of Baluchistan (Jewani, and Astola Island). They also appear in patches at Astola Island and Gwadar (Ministry of Environment 2009).

Wetlands and Ramsar Sites

Wetlands are extremely significant as they provide fundamental ecological services and are a source of biodiversity. Apart from these, they are of great economic, scientific, cultural and recreational significance. In comparison to other countries of the region, Afghanistan has fewer lakes and wetlands. Kol-i-Hashmant Khan, a seasonal wetland in Kabul, is a staging area for waterfowl. Ab-i-Estada is a saline wetland in Ghazni province. Both these wetlands are facing a threat of extinction due to water diversion and drought. The Sistan wetlands on the Iranian border form an important water bird habitat. The wetlands in Bangladesh comprise the three main rivers: Brahmaputra, Ganga, Meghna and its tributaries, around 6,300 beels[17], 47 major haors[18], baors[19], estuaries, mangrove forests and seasonal wetlands. These wetlands are rich in biodiversity, with around 150 species of birds and more than 80 species of mammals, reptiles and amphibians that are fully or partially dependent on wetlands. Wetlands comprise 49.40 percent of the total country area (Department of Environment 2010). The wetlands in India range from high altitude cold desert wetlands to hot and humid wetlands in coastal zones. India has a total of 757,060 wetlands, covering 4.6 percent of the total land area. The wetlands of Nepal comprise about 2.6 percent of the geographical area of the country and provide a habitat for 172 species of animals, birds and plants. The Indus Valley Wetlands in Pakistan are of great importance as they are an area of endemism. Similar to the rest of the region, Sri Lanka's wetland ecosystem is also diverse, comprising 103 major rivers and their associated marshes and around 12,000 irrigation tanks that harbour wetland species.

17 Permanent and seasonal shallow lakes in floodplain depression
18 Deeply flooded depressions in north-east
19 Oxbow lakes

Box 10: The Ramsar Convention

The Convention on Wetlands of International Importance or the Ramsar Convention is an inter-governmental treaty that provides the framework for national action and international cooperation for the conservation and judicial use of wetlands and their resources. A total of 164 countries are party to the Ramsar Convention. Upon joining the Ramsar Convention, each Contracting Party is obliged by Article 2.4 of the treaty to designate at least one wetland site for inclusion in the List of Wetlands of International Importance. Countries in South Asia are also signatories to the Ramsar Convention. The number of wetlands in India, Nepal and Sri Lanka has grown significantly since 2005.

Source: www.ramsar.org

Table 14: Ramsar Sites in South Asia

Country	Number of Sites in 2010	Number of Sites in 2013	Total Area in 2013 (Ha)
Bangladesh	2	2	6,11,200
Bhutan	2	2	25,619
India	19	26	6,89,131
Nepal	4	9	34,455
Pakistan	19	19	13,43,627
Sri Lanka	3	6	1,98,172

Source: www.ramsar.org

Box 11: Protected Areas

According to IUCN, a protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values. Terrestrial protected areas include national parks, wildlife sanctuaries, UNESCO biosphere reserves and World Heritage Sites, Ramsar Wetlands and other protected sites.

Bhutan and Sri Lanka have a high percentage of Protected Areas (PAs) with 51.4 percent and 28 percent, respectively, of their total land area. The Royal Botanical Park covers 0.12 percent of the land area of Bhutan. Currently, there are 10 PAs in Bhutan. All the protected areas are connected with biological corridors, which constitute about 8.6 percent of the total land area.

Photo 22: Band-i-Amir, Afghanistan

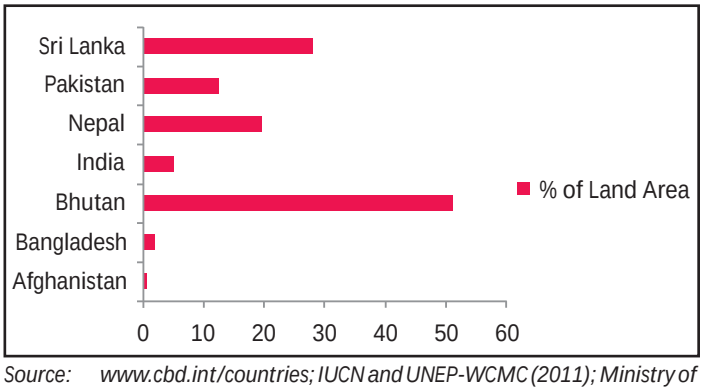
Photo Credit: Alex Treadway, ICIMOD

In comparison, Bangladesh and Afghanistan have negligible areas assigned as PAs. There are no legally established protected areas in Afghanistan at the moment, although Band-i-Amir is poised to become a provisional national park. Efforts are also being made to establish PAs in the Ajar valley, Big Pamir and Koh-i-Baba range. Bangladesh has 34 PAs. Apart from wildlife sanctuaries, national parks and game reserves, there are seven ex-situ conservation areas in the form of botanical gardens, eco-parks and safari parks. The Department of Environment, Bangladesh has included nine areas that are significant for biodiversity as Ecologically Critical Areas (ECAs) in the country. The rivers Buriganga, Sitalakhya, Turag and Balu and their basins were announced as ECAs in 2009.

A network of 690 PAs has been established in India, extending over 16 million hectares (4.90 percent), of the country's geographical area. It comprises 102 National Parks, 527 Wildlife Sanctuaries, 57 Conservation Reserves and four Community Reserves. There has been a steady increase in the number and area covered under PAs in the hotspot region. Presently, there are 137 Protected Areas (PAs) (47,208 km^2) in the Indian Himalayan Region (IHR) and88 PAs (13,695 km^2) in Western Ghats. In all, 39 Tiger Reserves and 28 Elephant Reserves have been designated for species specific management of habitats.

Maldives has five PAs. A total of 16 PAs have been established in Nepal, covering an area of 28,999 km^2 i.e. 19.7 percent of the total land area. These PAs comprise a total of nine national parks (35.5 percent of the total protected areas), three wildlife reserves (3.37 percent), three conservation areas (39.05 percent), one hunting reserve (4.56 percent) and 11 buffer zones (17.52 percent). Pakistan has designated 25 national parks, 97 game sanctuaries and 104 game reserves covering 9,852,006 hectares of land area.

Figure 29: Percentage of Terrestrial Protected Areas



Source: www.cbd.int/countries; IUCN and UNEP-WCMC (2011); Ministry of Agriculture and Forests, Government of Bhutan 2011

Trans-boundary protected areas (TPAs) are gaining importance in the region as many zones of high biodiversity are located along borders. A task force has been constituted in India to identify potential trans-boundary protected areas. A national consultative process for planning and establishing TPAs has been initiated. Five TPAs have been identified for enhancing regional cooperation with neighbouring countries out of the 24 PAs featured in the regional network of TPAs under the IUCN framework. The Sacred Himalayan Landscape is a proposed trans-boundary conservation area, covering 39,021 km^2, of which 73.5 percent falls into Nepal, 24.4 percent falls into Sikkim and Darjeeling of India and the remaining 2.1 percent falls in Bhutan. The Kanchenjunga Complex is another proposed trans-boundary landscape and is shared by Bhutan, China, India and Nepal.

Table 15: Marine Protected Areas in South Asia

Country	% of Territorial Seas covered	Number of Protected Areas
Bangladesh	0.81	9
India	1.67	130
Maldives	--	25
Pakistan	1.83	18
Sri Lanka	1.06	17

Source: IUCN and UNEP-WCMC (2011)

Box 12: UNESCO World Heritage Sites

World Heritage Sites are designated by UNESCO's World Heritage Committee. The natural sites selected possess exceptional natural beauty and have an aesthetic importance. They display outstanding examples representing the on-going ecological and biological processes in the evolution of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals. They are usually significant natural habitats for in-situ conservation of biological diversity and comprise endangered species of outstanding universal value from the viewpoint of science or conservation. The following are the World Heritage Sites in South Asia:

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), Western Ghats (2012). 39 sites were inscribed on the World Heritage list in 2012

Nepal: Sagarmatha National Park (1979), Chitwan National Park (1984)

Sri Lanka: Sinharaja Forest Reserve (1988), Central Highlands of Sri Lanka (2010)

Source: whc.unesco.org/en/text

Genetically Modified Organisms

Biotechnology can be used for a wide range of purposes like genetic improvement of plant varieties and animal populations to increase their yields; diagnosis of diseases; development of vaccines etc. The technology has been used extensively in the agriculture sector to improve crop yields, produce pest and disease resistant crops etc. This has been done through modification of the genetic material by introduction of a gene from a different organism to produce genetically modified (GM) or transgenic crops. Among the developing countries, India, (along with Argentina, Brazil and China), is one of the largest producers of GM crops. Insect resistant cotton crops are the most important commercially produced GM crop in the region. Bt *(Bacillus thuringiensis)* cotton is the pest resistant variety mainly grown in the region. It is grown in India and Pakistan. The Government of Bangladesh is going to release four varieties of genetically modified egg plants (Bt Uttara, Bt Kajla, Bt Noyontara and Bt Isd 006) in the country[20]. The Bangladesh Agriculture Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI) have undertaken confined field trials of transgenic potato and golden rice.

Various concerns related to environment and safety issues are associated with GM crops. Environmental concerns include introduction of transgenes into wild species of crops, effect on non-target organisms and loss of biodiversity. As a result, it is necessary to establish a regulatory process for monitoring the effects and approval of GM varieties. The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international treaty governing the movements of living modified organisms (LMOs), resulting from modern biotechnology from one country to another. It establishes an advance informed agreement (AIA) procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory. All the countries in the region (except Nepal) have ratified the Cartagena Protocol.

20 Http://www.dhakatribune.com/wellness/2013/jul/22/brinjals-bt-genes-be-released

Table 16: Biodiversity in South Asia: An Overview

Country	Biodiversity Overview
Afghanistan	Although information is scarce, recent investigations have suggested that the country's biodiversity has suffered enormously in the last three decades. Afghanistan can be broken down into 15 smaller eco-regions of which four are considered as critical/endangered, eight as vulnerable and only two as relatively stable and intact. There are 137-150 species of mammals, 428-515 birds, 92-112 reptiles, only 6-8 amphibians, 101-139 fish, 245 butterflies, and 3500-4000 vascular plant species native to Afghanistan. Seven vertebrate species are known to be endemic to Afghanistan, but estimates for endemic plant species range from 20-30 percent. Afghanistan is an arid country and the few wetlands that do exist are therefore of great significance to biodiversity. Afghanistan was one of the most significant centres for the origin and development of humanity's crop plants. Consequently, there are numerous local land races of wheat and other crops in use by Afghan farmers. Nine local breeds of sheep are found in Afghanistan along with eight breeds of cattle and seven of goats.
Bangladesh	The four broad types of ecosystems in Bangladesh are coastal and marine ecosystems, inland freshwater ecosystems, terrestrial forest ecosystems, and man-made ecosystems. Wetlands are the most important natural ecosystems of Bangladesh. There is an occurrence of wide genetic variations in plants and animals, both in wild and cultivated/ domesticated states. The diverse agro-ecosystems of Bangladesh are rich in genetic resources of plants and animals. There are 6,000 varieties of rice known to have existed in the country. In addition, habitat loss is considered as the single largest threat to biodiversity. Other threats include over-harvesting of resources and natural calamities.
Bhutan	Bhutan's ecosystems are represented by sub-tropical forests, warm and cool broad-leaved forests, evergreen oak forests, chir pine forests, alpine meadows, and more. A small Eastern Himalayan country, it ranks in the top ten percent of countries with the highest species richness per unit area in the world. Bhutan has 5,603 vascular plant species of which 105 are endemic, 667 bird species, 200 mammal species, 83 fresh water fishes, and uncounted invertebrate species. To protect its biodiversity, Bhutan has the highest proportion of forest cover and protected areas of any Asian nation. Bhutanese farmers primarily cultivate traditional crop varieties and depend on forest resources for their livelihood.
India	India is one of the 17 "mega diverse" countries and is composed of a diversity of ecological habitats like forests, grasslands, wetlands, coastal and marine ecosystems, and desert ecosystems. Endemism of Indian biodiversity is significant with 4045 species of flowering plants, 16,214 insects, 110 amphibians, 156 reptiles, 69 birds and 38 mammals endemic to the country. In this century, the Indian cheetah, Lesser Indian rhino, Pink-headed duck, Forest owlet and the Himalayan mountain quail are reported to have become extinct and several other species (39 mammals, 72 birds and 1,336 plants) are identified vulnerable or endangered.
Maldives	The greatest diversity of life in the Maldives occurs in the coral reefs of this island nation. At least 1090 species of fish and 187 coral species have been recorded. The islands are typical coral islands with limited life on land. About 583 species of plants have been recorded, 260 of which are believed to be native or naturalized and 323 species constitute cultivated plants that were introduced for agriculture and ornamental purposes. In addition, some 170 bird species have been identified.

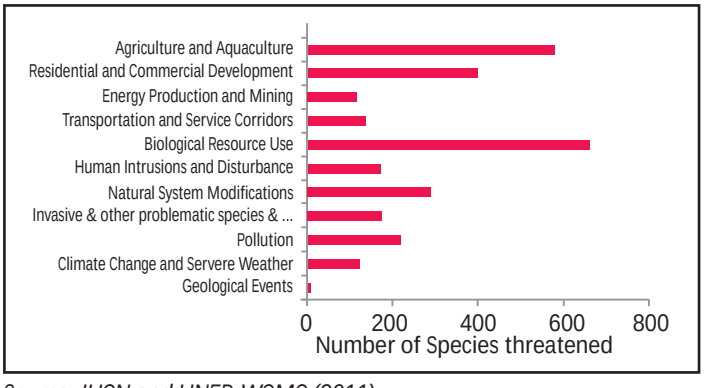
Country	Biodiversity Overview
Nepal	Nepal, situated in the Central Himalaya, has diverse physiographic zones, climatic contrasts and altitudinal variations, which provide habitats for biological species of both Indo-Malayan and Palaeoarctic realms, including endemic Himalayan flora and fauna. The major ecosystems include mountain, forest, rangeland, wetland and agricultural ecosystems. Nepal has only about 0.1 percent of the world's total land area but harbours over 2 percent of the flowering plants, 3 percent of Pteridophytes and 6 percent of bryophytes of the world's flora. In addition, about 5 percent (246 species) of the total flora known is endemic. Nepal possesses more than 400 species of agricultural crops, 50 of which have been domesticated for commercial and household consumption. Approximately, 342 plant species and 160 animal species have been reported as being endemic to Nepal. A total of 27 Important Bird Areas (IBA) hosting richest bird species and 54 Important Plant Areas (IPA) have been identified.
Pakistan	Pakistan spans a remarkable number of the world's broad ecological regions, including four biomes: the desert biome, temperate grassland biome, tropical seasonal forest biome, and mountain biome. Pakistan fauna includes 668 birds, 198 freshwater fishes (29 endemic), 177 reptiles (13 endemic), and 174 mammals (6 endemic). About 5,700 species of flowering plants have also been identified.
Sri Lanka	In terms of species, genes and ecosystems, Sri Lanka has a very high biodiversity and is one of the 18 hot spots in the world. The wet zone rainforests have nearly all of the country's woody endemic plants and about 75 per cent of the endemic animals. The genetic diversity of agricultural crops is quite remarkable, with 3,000 accessions of rice being recorded. The biodiversity of coastal and marine ecosystems provide over 65 percent of the animal protein requirement of the country. Sri Lanka has the highest biodiversity per unit area of land among Asian countries in terms of flowering plants and all vertebrate groups except birds. The vegetation of Sri Lanka supports over 3,350 species of flowering plants and 314 species of ferns and fern allies. There is also considerable invertebrate faunal diversity. The crop genetic diversity in the country is also high, especially for Oryzasativa. In addition to the diversity seen in coarse grains, legumes, vegetables, roots and tubers and spice crops, there are over 170 species of ornamental plants. Among domesticated animals of economic value are some indigenous species of buffalo, cattle, fowl and fish.

Source: www.cbd.int/countries

3.4.2 Issues and Pressures

The figure below lists the major pressures on the biological wealth of the region and the number of species affected. Biological resource use is the biggest pressure on biodiversity, followed by agriculture and aquaculture.

Figure 30: Number of Species under Threat in South Asia from Various Activities and Events

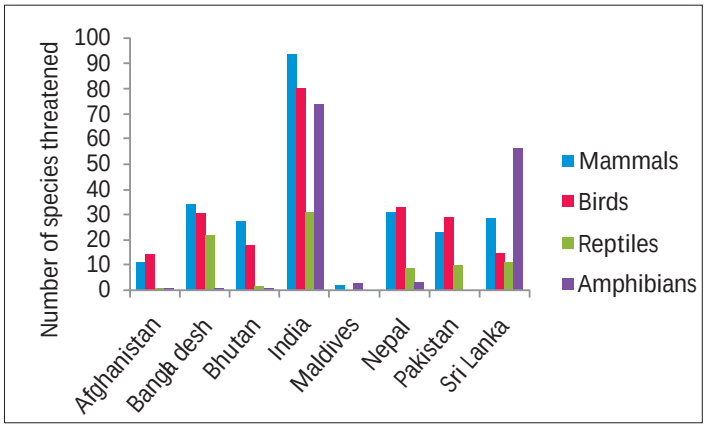


Source: IUCN and UNEP-WCMC (2011)

Habitat Loss and Disturbance

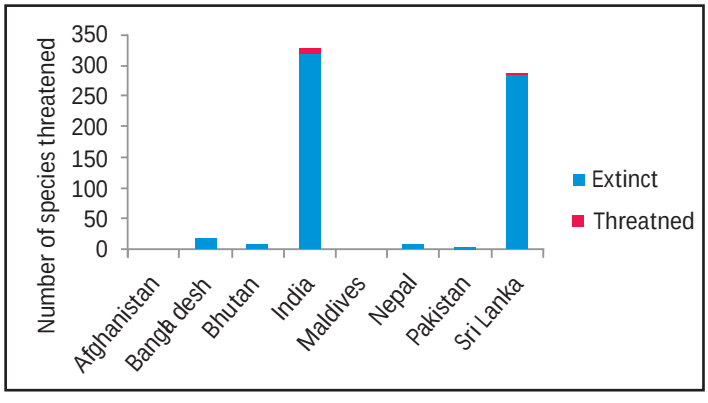
One of the primary threats to biodiversity in South Asia is the habitat loss caused by agriculture and aquaculture, residential and commercial development, transport and service corridors and energy production and mining. In all, 48 percent of all threatened plant and animal species face risks from such activities. Deforestation is occurring to make way for agriculture, for human settlements, and logging for commercial timber. The spread of monoculture plantations has also resulted in a loss of agro-biodiversity. The diversion of water for irrigation is a major cause of wetland degradation in Pakistan. A total of 169 billion cubic metres of water is diverted for canal irrigation, thus leaving only a quarter of the water to reach the Indus delta and the Arabian Sea.

Figure 31: Number of Threatened Mammals, Birds, Reptiles and Amphibians in South Asia



Source: IUCN (2012)

Figure 32: Number of Threatened Plant Species in South Asia

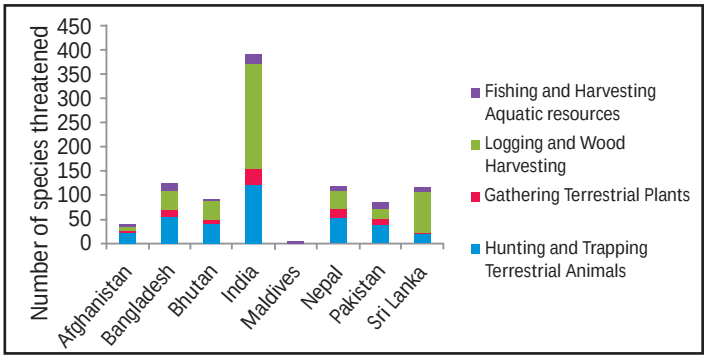


Source: IUCN (2012)

Pollution

In the region, water and soil pollution is caused predominantly by contamination from fertilizers, pesticides, weedicides and untreated sewage and waste water. Decreased levels of oxygen in water and eutrophication are a grave threat to marine biodiversity. In coastal areas, chemical compounds from shrimp farms, the dumping of solid untreated industrial waste and release of waste oil and tar from ships impact biodiversity negatively.

Figure 33: Species Threatened from Over–exploitation of Biological Resources



Source: IUCN and UNEP-WCMC (2011)

Unsustainable Exploitation

The over-exploitation of natural resources is one of the most significant threats to biodiversity in the region. In fact, 663 plant and animal species in the region are threatened by over-exploitation. This includes unintentional and deliberate threats to valuable species from logging gathering terrestrial plants, hunting and trapping terrestrial animals, and fishing as well as harvesting aquatic resources. Although overexploitation is often difficult to quantify in terrestrial systems, major exploited groups include plants for timber, food and medicine; mammals for wild meat and recreational hunting; birds for food and the pet trade; and- amphibians for traditional medicine and food (Vié *et al.* 2009). In Afghanistan, indiscriminate hunting of wild animals is a serious problem. India, Nepal, Pakistan and Sri Lanka are particularly affected by the unsustainable collection of medicinal plants from the wild. In wetlands and coastal areas, over fishing is also a cause of the depleting biodiversity. Coral reefs are facing stress due to over-fishing and destructive fishing, industrial and coastal development and increased sedimentation.

Box 13: Impacts of Oil Spill on Biodiversity

The oil spill in Mumbai, India, occurred when MSC Chitra and MV Khalija 3 collided off the coast near Mumbai on 7th August, 2010. Due to the collision, MSC Chitra tilted to about 80 degrees after the collision and spilled approximately 400 tonnes of oil in the initial hours. During the accident, there was a spillage of about 879 tonnes of oil which traveled long distances to the various coastlines of the Mumbai Metropolitan region and nearby areas (Mumbai, Thane and Raigad district). The oil spill impacted the biodiversity of the region. The mangrove stretch along the shore was also affected. The degree of impact varied with the location. The spill took place in the seeding season of mangroves. Oil slicks were mainly sighted in the mangroves of Elephanta island, Vashi creek and some fringes of Mahul-Shewri. About 1273 hectares of mangroves were found completely covered with oil. Another 302 hectares of mangroves in Colaba were damaged, making it the worst affected area, followed by Trombay at 289 hectares and Vashi at 252 hectares. It was also estimated that the spill would affect fish species since a majority of fish breed in the mangroves.

Source: CNN IBN; NEERI (ND)

Climate Change

Biodiversity will be impacted by climate change directly and indirectly through a shift and alteration in habitats, severe weather conditions and extreme events. Sea level rise will induce greater flooding and cause damage to coastal ecosystems. Reduced glacial cover in the Hindu-Kush Himalayan range will induce biodiversity loss in the mountain and low lying ecosystems. In India, climate change is projected to lead to the loss of savanna cover and wildlife adapted to this landscape could be threatened by the loss of its habitat. Increased temperatures can also raise the risks from fire outbreaks. Forest fire is one of the gravest threats to the forests of Bhutan. Climate change also increases the threat of desertification in Afghanistan, India and Pakistan. Increased frequencies of drought could impact wetlands and erode their ability to regulate water quality and quantity. This is of great significance to Pakistan, where wetlands cover 9.7 percent of the country.

Climate change is a major threat to the coral reefs of the region. Impacts of global warming, variable precipitation, extreme weather events and sea-level rise are being felt in the region. Coral bleaching is a negative impact caused due to ocean warming. An ocean warming of 1°C to 2°C can cause bleaching of coral reefs, weakening the health and services of corals and dependent species and distorting the dynamics within the ecosystem. A large-scale bleaching event occurred in 1998. Variable impact was seen across the region, with upto 90 percent mortality in many areas including Lakshadweep, Maldives and Sri Lanka.

Over the years, recovery of the coral reefs has been observed. A higher coral cover was found on the western atolls and the Bar Reef in Sri Lanka. However, the tsunami in 2004 has caused significant reef damage, especially in Andaman and Nicobar islands.

Photo 23: Tigers-Endangered due to Habitat Loss and Poaching

Photo Credit: WWF-India

Table 17: Threats to Ecosystems in South Asia

Ecosystems	Threats	Afghanistan	Bangladesh	Bhutan	India	Maldives	Napal	Pakistan	Sri Lanka
Coastal (mangroves, mudflats, estuaries)	Inundation, salination, storm, species loss								
Coral reefs	Bleaching, acidification, loss of ecological and protective services, reduction in species diversity								
Inland wetlands	Desiccation, drainage and diversion degradation and service loss								
Forests	Loss of forest cover and species, altered composition and structure, enhanced evapotranspiration								
Mountain (subtemperate, temperate)	Altitudinal shift in vegetation disrupting species types								
Mountain (subalpine, alpine)	Loss of vegetation cover								
Glaciers	Loss of coverage								
Desert	Expansion								
Rangeland & Grasslands	Regime shift, degradation due to overgrazing and increased incidence of fire								
Freshwater (rivers, lakes)	Desiccation, increased salinity at coast, degradation due to increased demand								
Species diversity (floral & faunal)	Loss of diversity and habitat, changes in species composition and food web								
Key:	Locations particularly vulnerable to impacts of climate change.								

Source: Rahimsala and Joshi (2009)

Box 14: Sea Level Rise and the Biodiversity of the Bangladesh Coastal Area

Bangladesh is particularly at risk from the sea-level rise, given that its coastal zone, comprising intertidal mudflats, mangroves, and tidal creeks, covers about 30 percent of its area. These coastal ecosystems are habitat for many species, sources of livelihood for many communities and a natural defence against storms and floods. The coastline mangroves of the Sunderbans will be threatened by the increase in inundated areas and salinity of water.

The Sunderbans supports a diversity of wildlife: Bengal tigers, Indian otters, spotted deer, wild boards, some of the largest estuarine reptiles and endangered turtles. A moderate increase in sea level could disturb this wildlife and spur conflict between humans and animals. A one-metre rise in the sea level, which is likely to occur by the end of the century, will lead to the disappearance of the Sunderbans and its biodiversity.

Source: IPCC (2001)

Invasive Alien Species

Invasive alien species pose a growing threat to biodiversity. Freshwater biodiversity in the region is being impacted through the accidental and intentional introduction of alien invasive plants and animals. Exotic waterweeds such as Salvinia *(Salvinia molesta)* and water hyacinth, introduced accidentally, have caused serious environmental and economic damage by reducing the functional area of wetlands, creating problems in irrigation tanks, and causing a loss in terms of the number of native species. Heavy agricultural losses are also being caused by terrestrial invasive species. A number of forest ecosystems have also been impacted. Some other invasive species such as *Lantana camara, Parthenium hysterophorous, Miania micrantha* are also widespread in the region. The problem of introduced exotic fish species in wetlands has caused severe losses in local fish species in Bangladesh, India, Nepal and Sri Lanka. Water hyacinth has been recognized as one of the top ten worst weeds in the world (Patel 2012). It has been detected in Sunderbans in Bangladesh (Biswas *et al.* 2007) and in the wetlands of Kaziranga National Park. Its infestation can also be observed in Deepor Beel, a freshwater lake formed by the Brahmaputra River in lower Assam (Patel 2012).

Illegal Trade

One of the major threats to biodiversity is the illegal trading of wildlife, which poses a major challenge to the conservation efforts in the region. In India, trading is done for diverse products including mongoose hair; snake skins; rhino horn; tiger and leopard claws, bones, skins, whiskers; elephant tusks; deer antlers; shahtoosh shawls; turtle shells; musk pods; bear bile; medicinal plants; timber and caged birds such as parakeets, mynas and munias. Hunting and trapping are major threats to biodiversity in Afghanistan. Various species like tiger and elephant, snow leopard and other big cats, one-horn rhino, pangolin, brown bear, deer, reptiles, seahorse, star tortoise, butterflies, peacocks, birds, red sander, orchids, shells, and corals are seriously endangered or even on the brink of extinction in the region, mainly because of rampant poaching and unscrupulous illegal trade of wildlife for the sale of hides, trophies, ornamental plants, musical instruments and for traditional medicine, often in global markets.

3.4.3 International Agreements and Initiatives

The Convention on Biological Diversity

Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Sri Lanka and Pakistan are all Parties to the Convention on Biological Diversity (CBD). The CBD has a Strategic Plan for Biodiversity 2011-2020, of which the Aichi Biodiversity Targets are a crucial part. This plan is to be implemented at a national level, and countries can set national targets, commitments and policy instruments based on their priorities, which are then set down through National Biodiversity Strategy and Action Plans (NBSAPs). So far, the countries of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka have prepared NBSAPS and Afghanistan is yet to do so.

The member countries have enacted various laws and legislations to protect and conserve biodiversity. Government of India has enacted the Biological Diversity Act (2002) and Rules (2004). This Act mainly aims to conserve the biological diversity, and ensure the sustainable use of resources. The National Biodiversity Authority (NBA) was set up in 2003 by the Government of India to implement the different provisions of the Biological Diversity Act (2002) and Biological Diversity Rules (2004) . There are many laws in Pakistan covering areas such as forestry and wildlife protection, for example, Sindh Wildlife

Protection Ordinance (1992); Punjab Wildlife (Protection, Preservation, Conservation and Management) Act (1974); Baluchistan Wildlife Protection Act (1974); NWFP Wildlife (Protection, Preservation, Conservation and Management) Act (1975); Northern Areas Wildlife Preservation Act (1975); Azad Jammu and Kashmir Wildlife Preservation Act (1975); and Islamabad Wildlife Wildlife (Protection, Preservation, Conservation and Management) Ordinance (1979) .

Other Relevant Multilateral Environment Agreements

- Convention on the Trade in Endangered Species (CITES)
- Convention on Migratory Species of Wild Animals (CMS)
- Ramsar Convention on Wetlands (Ramsar)
- Convention Concerning the Protection of the World Cultural and Natural Heritage (WHC)

The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization* was adopted by the Conference of the Parties to the Convention on Biological Diversity at its tenth meeting on 29 October, 2010 in Nagoya, Japan. In South Asia, Bangladesh Bhutan and India are signatories to the Nagoya Protocol.

UNESCO's Man and Biosphere Programme

Biosphere reserves are sites established by countries and recognized under UNESCO's Man and the Biosphere (MAB) Programme to promote sustainable development based on local community efforts and sound science.

These reserves seek to reconcile conservation of biological and cultural diversity and economic and social development through partnerships between people and nature. Therefore, they are ideal to test and demonstrate innovative approaches to sustainable development from local to international scales.

India has eight Biosphere Reserves, Maldives has one, Pakistan has one and Sri Lanka has four.

The entire Maldives nation has pledged to become a United Nations Educational Scientific and Cultural Organization (UNESCO) Biosphere Reserve. The island nation plans to implement the reserve plan on more than half of its islands by 2017.

3.4.4 Regional Cooperation

Strengthening Regional Cooperation for Wildlife Protection in Asia

The objective of the World Bank funded project 'Strengthening Regional Cooperation for Wildlife Protection Project' is to assist the participating governments of Bangladesh and Nepal to build or enhance shared capacity, institutions, knowledge and incentives to collaborate in terms of tackling illegal wildlife trade and other selected regional conservation threats to habitats in border areas. There are three components of the project. The first component is capacity building for addressing the illegal trans-boundary wildlife trade. This component aims to bring about regional harmonization and collaboration in combating wildlife crime through strengthened legislative and regulatory frameworks, well-equipped specialized agencies and systems, as well as relevant training and awareness programmes for the staff across the range of agencies that contribute to the enforcement of wildlife laws and regulations. The second component is promoting wildlife conservation in Asia. The third component is coordination and communication. This component would provide services, technical assistance (TA) and incremental costs for project staff as well as the operating costs for the management and coordination of the project.

Mangroves for the Future

Bangladesh, India, Maldives, Pakistan and Sri Lanka are part of a regional initiative for coastal sustainability called Mangroves For the Future (MFF). It is a partnership-based initiative promoting investment in coastal ecosystems for sustainable development. MFF has adopted mangroves as its flagship ecosystem in recognition of the important role that mangrove forests played in reducing the impact of the 2004 Indian Ocean tsunami, and the severe effect on coastal livelihoods caused by the loss and degradation of mangroves. MFF embraces all coastal ecosystems, including coral reefs, estuaries, lagoons, wetlands, beaches and sea grass beds. The mission of MFF is to promote healthy coastal ecosystems through a partnership-based, people-focussed, policy-relevant and investment-orientated approach, which builds and applies knowledge, empowers communities and other stakeholders, enhances governance, secures livelihoods, and increases resilience to natural hazards and climate change.

South Asian Seas Programme

To address these critical problems, the South Asian Seas Action Plan (SASAP) was adopted in March 1995, supported by Bangladesh, India, Maldives, Pakistan and Sri Lanka. The overall objective of the SASAP is to protect and manage the marine environment and related coastal ecosystems of the region in an environmentally sound and sustainable manner. SACEP is acting as the Action Plan secretariat.

SASAP focuses on Integrated Coastal Zone Management (ICZM), oil-spill contingency planning, human resource development and the environmental effects of land-based activities. Although there is no regional convention yet, SASAP follows the existing global environmental and maritime conventions and considers Law of the Sea as its umbrella convention.

One of the SASAPs priorities focuses on National Action Plans and pilot programmes to implement the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). Another immediate priority is environmental assessment and monitoring, including the data collection and management. In the future, SASAPs ultimate goal is to set up Regional Activity Centres in each of the participating countries, each dealing with the action plan priorities.

South Asia Coral Reef Task Force

The South Asia Coral Reef Task Force (SACRTF) was established to facilitate coordination in the management of coral reefs and associated ecosystems at the national level, and to promote collaborative action at the regional level, encouraging trans-boundary responses to shared environmental challenges. SACRTF was endorsed by the country governments of the five maritime nations of South Asia, at the SACEP Governing Council Meeting in Nepal, in January 2007. Since its inception, three official meetings of members have been held. In response to this initiative, India and Pakistan have established their National Task Forces. Implementation of a training and exchange programme was organized for MCPA managers from across the region, using the resource 'Managing Marine and Coastal Protected Areas: A Toolkit for South Asia'. Apart from these initiatives, mass awareness raising events have also been conducted.

South Asia Wildlife Enforcement Network (SAWEN)

SAWEN is a regional network of Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. This network came to the fore after recognizing the dire need of its formation and the establishment of South Asia Experts Group on Illegal Wildlife Trade. SAWEN was formally launched during the Second Meeting of the South Asia Experts Group on Illegal Wildlife Trade, held from 29-30 January 2011 in Paro, Bhutan. The meeting agreed to an action-oriented work plan for joint activities, establishment of the SAWEN Secretariat, hosted by the Government of Nepal, governance and operational structure of SAWEN, and the need for strategic collaboration on communications and fund-raising. The SAWEN Secretariat was formally established on 20th April, 2011 in Kathmandu, Nepal, and housed under the Department of National Parks and Wildlife Conservation (DNPWC), Ministry of Forests and Soil Conservation, Government of Nepal. The Director-General of DNPWC serves currently as the Chief Enforcement Coordinator of SAWEN.

Photo 24: Community Forestry Involves Local Communities in Forestry Activities

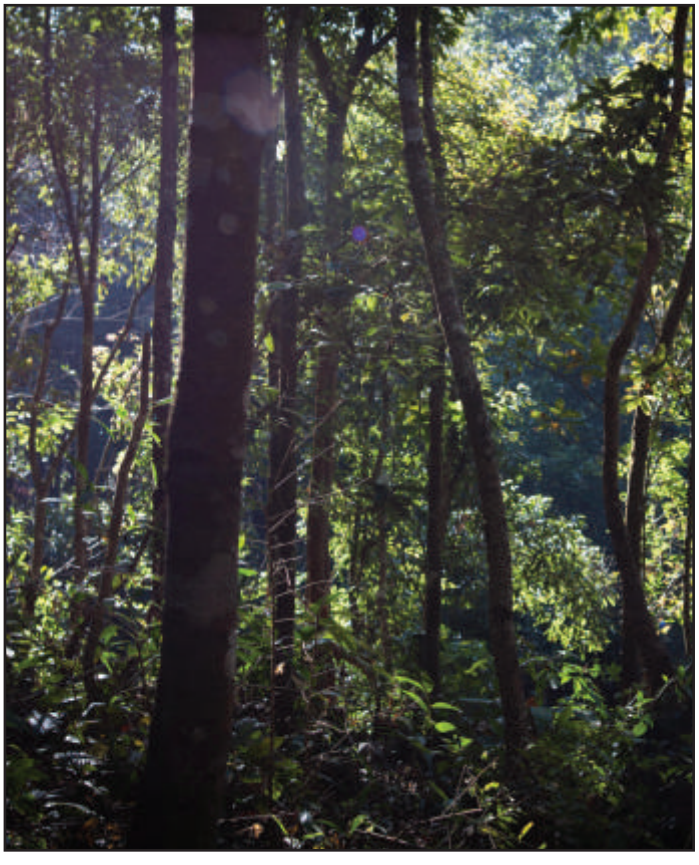


Photo Credit: Nabin Baral, ICIMOD

Box 15: Ecosystem Service Valuation

According to the Millennium Ecosystems Assessment, ecosystem services are the benefits people derive from the ecosystem. Biodiversity and ecosystems are closely related. Changes in biodiversity can influence the services provided by the ecosystem.

Ecosystem Service Valuation (ESV) is gaining significance in the light of increasing loss and degradation to ecosystems and biodiversity. Valuation can be used to assess the total contribution of ecosystems to human well-being. It can also be used as a tool to assist decision makers in policy making.

The Economics of Ecosystem and Biodiversity (TEEB) is a global initiative that highlights the cost of biodiversity loss and ecosystem degradation. It also supports the mainstreaming of biodiversity and ecosystem considerations into policy making. A TEEB project was launched in India in 2011 to recognize, demonstrate and capture the value of ecosystem services in India, and targets policy actions at national and state levels. Wetlands, forests and marine ecosystems have been identified as priority areas. The government aims to finalize a framework for green national accounts by 2015.

A study was conducted by IUCN in 2007 to evaluate the environmental and socio-economic value of mangroves in the tsunami-affected areas. Panama village situated on the banks of the mouth of the Wila Oya River is eastern Sri Lanka. Biodiversity valuation has been included in the document "Biodiversity Conservation in Sri Lanka - a Framework for Action (BCAP)". The government has also established an Environmental Economics and Global Affairs Division in the Ministry of Environment. Biodiversity conservation financing mechanisms through biodiversity valuation and economics of conservation is also mentioned as a strategy in the National Action Plan for Haritha Lanka Programme.

Under the "Indus for All Programme", five ecosystems in Pakistan were evaluated during 2007-08 for direct-use value, non-use value and indirect-use value. The ecosystems chosen were deltaic ecosystem, rangelands, freshwater ecosystem, forests and agriculture. The Gross National Happiness (GNH) of Bhutan also includes ecological accounts of the nation. A report titled "Initial Estimate of the Value of Ecosystem Services in Bhutan" was released in 2011, according to which the total value of 22 ecosystem services for nine different land cover types is US$15.5 billion per year.

Source: National Action Plan for Haritha Lanka programme, Kubiszewski et al. 2013

Community Forestry

According to FAO, "Community Forestry is defined as any situation which intimately involves local people in a forestry activity. It embraces a spectrum of situations, ranging from woodlots in areas which are short of wood and other forest products for local needs, through the growing of trees at the farm level to provide cash crops and the processing of forest products at the household, artisan or small industry level to generate income, to the activities of forest dwelling communities". The benefits of community forestry include employment in rural communities leading to economic development, protection of forests, watersheds etc. (that are important to the community), and improved awareness about forest management.

The *Bio-rights Programme* of East Kolkata is an innovative financial mechanism to integrate ecosystems approach to planning. It provides micro credits to local communities in return for active involvement in the conservation and restoration of wetlands. The micro credits are converted to definitive payments upon the successful delivery of conservation services at the end of a contracting period. The global and local stakeholders pay local communities to provide ecosystem services.

There has been a shift in the approach of forest management. The countries are actively seeking the involvement of local communities. In Bhutan, community forest was established in 1980. As of June 2011, 345 community forests were established covering an area of 40,1652 hectares, benefitting more than 15,979 households. Similarly, 627 private forests have been established so far. The concept of community forestry was introduced in India by the National Forest Policy (1988), which delegated the task of involving the tribal people for the protection, regeneration and development of forests as well as providing employment to the people living in and around the forests. Joint Forest Management (JFM) also aims to do the same by fostering partnerships between local user groups and forest departments. It also integrated village resource development, micro watershed development along with rehabilitation of degraded forestlands. India has more than 100,000 JFM committees managing 22 million hectares of forest area. In India and Nepal, one-third of public forests are managed by communities.

Forest Certification

Forest certification is a way of creating incentives for the managers to follow the best social and environmental practices. When forest operations meet certification requirements, the materials and products carry a label and provide businesses and consumers with a powerful tool to influence how forests worldwide are managed. The Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) are the two main forest management certification organisations. The total FSC certified forest in South Asia is 43,000 hectares. These forests are primarily found in India, Nepal and Sri Lanka. Most of the certified areas are planted forests. India is the only country involved with PEFC (FAO 2012).

Conclusion

The South Asian region is biologically rich as exemplified by the presence of a diverse range of ecosystems like forests, wetlands, marshes, protected areas as well as coastal and marine biodiversity. Biodiversity loss continues to occur in the region despite several conservation measures. The major pressures on biodiversity encompass habitat loss and fragmentation, overexploitation of resources, pollution, presence of invasive alien species, wildlife trade and climate change. Realizing the significance of conservation of biodiversity, countries have undertaken several measures for the same. However, the focus should be on ecosystem service evaluation and payment for ecosystem services as a means for biodiversity conservation.

Box 16: Community Forestry in Nepal

Community forestry in Nepal emerged in the late-1970s and led to the devolution of management and user rights to forest user groups, largely as a shift in the approach to conserve the hill forests in the context of degradation and deforestation. During the last three decades, Nepal's community forestry programme has evolved in terms of coverage and institutional innovation, supported through appropriate changes in policies and legislation. Substantial international support has also helped to sustain community participation. Community forestry appears to have stood the test of time in contributing to the welfare of the rural population. This has been facilitated by changes in policies and legislation which empowered the local communities. As of April 2009, 1.6 million households, or one-third of the country's population, are participating in community forestry, directly managing more than one million hectares or more than one-fourth of the country's forest area. As in the case of all institutional arrangements, there are both highly successful and less successful forest user groups. FECOFUN has become a powerful institution helping forest user groups to improve their efficacy, sustainability and equity.

Source: FAO 2012

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Photo Credit: Fritz Berger, ICIMOD

Photo Credit: Development Alternatives

Key Priority Issues

Chapter 4

Photo Credit: Atif Gulzar

Section IV highlights the key environmental issues like climate change, water, energy and food security and urbanization. These concerns are a threat to the sustainable development of South Asia. Like the previous section, these issues are also analyzed under the DPSIR framework.

4.1 Climate Change

Climate change refers to any significant change in the measures of climate like temperature, precipitation or wind patterns and other effects lasting for an extended period of time. In fact, it is the most important anthropogenic issue of current times. The main cause of climate change in the present context is the increasing concentration of GHGs. With the advent of industrialization, anthropogenic activities have resulted in accumulation of GHGs and the overall warming of the atmosphere and changing climate. This change in climate has manifested in the form of changing rainfall patterns, disruption in hydrological cycles, melting of ice caps and glaciers, rise in sea levels, and increase in the frequency and intensity of extreme events such as heavy precipitation and cyclonic activities. Impacts of this change have been felt on water resources, agriculture, forests and ecosystems, affecting the well-being of billions of people inhabiting our planet.

South Asia is physiographically diverse and ecologically rich in natural and crop-related biodiversity. The geography, demography and poverty of this region make it extremely vulnerable to climate change. For instance, the islands of Maldives in South Asia are most vulnerable to abnormal sea level changes. Comprising of developing countries, the impacts in South Asia are most pronounced. Hence, the focus in this region is on prevention and preparedness.

4.1.1 Observed Climate Trends in the Region

As mentioned earlier, increase in the concentration of greenhouse gases is responsible for climate change. The concentration of carbon-dioxide has been constantly increasing in the region. India and Pakistan are the major contributors to the emissions of CO_2 in the region. On the other hand, in terms of per capita emissions, Maldives is the highest contributor. However, the per capita emissions of the region are still far below the world average.

The Fifth Assessment report of IPCC finds it extremely likely (95 percent certainty) that the amplified concentration of GHGs in the atmosphere due to human activities is responsible for the observed warming. The observed climatic trends of the South Asian region are characterized by the increasing annual mean temperatures at a country scale during the 20th century. It is likely that the numbers of cold days and nights have decreased and the numbers of warm days and nights have increased since 1950s. Most of the areas of Asia lacked sufficient observational records to draw conclusions about trends in annual rainfall over the past century. Rainfall trends, including extremes, are characterized by strong variability, with both increasing and decreasing trends observed in different parts and seasons of Asia. In South Asia, seasonal mean rainfall shows interdecadal variability, noticeably a declining trend with more frequent deficit monsoons. However, the frequency of heavy precipitation events is increasing while light rain events are decreasing (IPCC 2014).

Table 18: Key Observed Past and Present Climate Trends in South Asia

Country	Change in Temperature	Change in Precipitation
India	Increase in annual mean temperature of 0.56°C per 100 years during the period 1901-2007. Accelerated warming has been observed in the recent period (1971-2007), mainly due to intense warming in the recent decade (1998-2007). This warming is mainly contributed by the winter and post-monsoon seasons, which have increased by 0.70°C and 0.52°C, respectively in the last 100 years.	Increase in extreme rains during summer monsoon in recent decades
Afghanistan	Mean annual temperature has increased by 0.6°C since 1960, at an average rate of around 0.13°C per decade. The frequency of hot days and hot nights has increased every season; similarly the frequency of cold days and nights, annually, has decreased since 1960.	Mean rainfall has decreased slightly (an average rate of 0.5 mm per month per decade) since 1960.
Bhutan	Rise in mean summer and winter temperatures have been observed. However, due to the short time series, the rise in temperature was not quantified.	No detectable trends in precipitation from 2000 to 2009.
Sri Lanka	Increasing annual maximum temperature with rates upto 0.046°C from 1961 to 2000.	A decreasing trend of 9.46 mm per year was observed in the mean annual rainfall from 1961 to 2000.

Source: Compiled from National Communication to UNFCCC of Different Countries

4.1.2 Extreme Climatic Events

Longer duration of heat waves has been observed in the region. This is especially true for India (De and Mukhpadhyaya 1998). Also, the frequency of occurrence of intense rainfall events has increased in Asia, causing severe landslides, floods and debris and mud flows (Khan *et al.* 2000; Shrestha *et al.* 2000; Mirza 2002). Since 1984, Bangladesh has experienced six severe floods. In 2007, two successive and damaging floods inundated the country in the same season (MoEF 2008). Floods in Mumbai in 2005 have been attributed to both climatic and non-climatic factors suggesting an interaction between climate change and other stresses. In 2010, almost 2000 people died in floods in Pakistan, leaving behind 20 million homeless and incurring a loss of $10 billion. Floods and landslides are an annual occurrence in the southern and eastern foothills of Bhutan (NEC 2008). Bhutan was affected by three major floods from 2009 to 2013. The frequency and intensity of droughts have also increased in many parts of Asia due to the rise in temperature, particularly during summers and normally drier months and also during ENSO events (Webster *et al.* 1998; PAGASA 2001; Lal 2003). The number of cyclones originating from the Bay of Bengal and Arabian Sea has decreased since 1970, but their intensity has increased. The damage caused by cyclones has risen significantly in countries like India and Bangladesh. In fact, South Asian countries are the most vulnerable countries in the world in terms of floods and cyclones (UNDP 2004). In Sri Lanka alone, the total number of people affected by floods from 2005 to 2014 were 4,626,078 (EM-DAT 2014).

Box 17: Multi-Purpose Cyclone Shelters in Bangladesh

The Southern districts of Bangladesh along the Bay of Bengal are prone to cyclones. Construction of cyclone shelters is one of the major mitigating measures deployed in the country along with other measures like embankments, afforestation, early warning systems, awareness building and communication. A shelter is a concrete building, shaped like two sides of a triangle, facing the wind. To enter, people climb the staircase at the back, as it is more sheltered from the wind. Railings are also placed on both sides of the staircase. Windows have metal shutters instead of glass to avoid casualty due to shattering of glasses. Some 700 to 1,000 people can take refuge in a shelter. Large shelters can accommodate upto 2,000 people. According to estimates, around 1.5 million people took refuge in these shelters when Cyclone Sidr hit the coast of Bangladesh in November 2007, helping them limit the fatalities to 3,500.

Source: Bangladesh Climate Change Strategy & Action Plan 2009, MoEF, Government of People's Republic of Bangladesh

Table 19: Most Vulnerable Countries to Floods (Left) and Cyclones (Right) (Deaths/100,000 People Exposed to Floods or Cyclones)

Venezuela	4.9	Bangladesh	32.1
Afghanistan	4.3	India	20.2
Pakistan	2.2	Philippines	8.3
China	1.4	Honduras	7.3
India	1.1	Vietnam	5.5
Bangladesh	1.1	China	2.8

Source: UNDP (2004)

Table 20: Observed Changes in Extreme Events & Severe Climate Anomalies

Country/ Region	Key Trends
South Asia	Serious and recurrent floods in Bangladesh, Nepal and North-East states of India during 2002, 2003 and 2004; Bhutan was affected by floods in 2009, 2011 and 2013; a record 944 mm of rainfall in Mumbai, India on July 26 and July 27, 2005 led to a loss of over 1,000 lives and a total loss of more than US$250 million; floods in Surat, Barmer and Srinagar during the summer monsoon season of 2006; 17 May, 2003 floods in southern province of Sri Lanka were triggered by 730 mm rain.
South Asia	50 percent of droughts associated with El Niño; consecutive droughts in 1999 and 2000 in Pakistan and North-West India led to a sharp decline in water tables; consecutive droughts between 2000 and 2002 caused crop failures, mass starvation and affected around 11 million people in Odisha; droughts in North-East, India during the summer monsoon of 2006.
South Asia	Frequency of monsoon depressions and cyclone-formation in Bay of Bengal and Arabian Sea on the decline since 1970, but intensity is increasing, causing severe floods in terms of damage to life and property.

Source: IPCC (2007)

20 Http://tribune.com.pk/story/521072/climate-change-pakistan-italy-join-hands-to-identify-adaptive-measures/

Photo 25: GLOF in Bhutan

Photo Credit: NEC Bhutan

4.1.3 Glacial Lake Outburst Floods (GLOF)

Glacial Lake Outburst Floods (GLOF) take place in heavily glaciered mountain regions and are triggered by natural forces such as heavy rains, landslides, avalanches and earthquakes. This leads to an overspill of water from the glacial lakes, a sudden increase in drainage and an outbreak of the glacial lake, resulting in floods that have the capacity to cause widespread damage to entire communities located downstream.

The cumulative frequency of GLOF events in Nepal, Bhutan and Tibet region of China depict a progressive increase from 1940 to 2000, approaching a total of 35 GLOF events by 2000 (Richardson and Reynolds 2000). Bhutan is highly prone to GLOFs (Watanabe and Rothacher 1996). Presently, Bhutan has 2,674 glacial lakes, formed due to the retreating processes of glaciers. Earlier, 24 lakes were identified as dangerous. Nine of these are located in the Pho Chhu Sub-basin, seven in the Mangde Chhu Sub-basin, five in the Mo Chhu Sub-basin, three in the Chamkhar Chhu Sub-basin, and one in the Kuri Chhu Sub-basin. GLOFs in Bhutan have taken place in 1957, 1960 and 1994 in the Pho Chhu sub-basin (NEC 2008). However, currently only two lakes have been identified as the most dangerous ones.

Bhutan had identified the following vulnerabilities in its National Adaptation Programme of Action (NAPA) released in 2006:

- Loss of lives and livelihoods through impacts on agricultural lands and people.
- Damage to infrastructure such as hydropower systems, industrial estates, human settlements, historical and cultural monuments, roads, bridges and communication infrastructure.

NAPA had also identified "Artificial Lowering of Thorthormi Lake", "GLOF Hazard Zoning" and "Installation of Early Warning System in the Pho Chhu Basin" as three of the nine prioritized NAPA projects. These adaptation priorities are being implemented under the project 'Reducing climate change induced risks and vulnerabilities from GLOF in the Punakha, Wangdi and Chamkhar valleys' funded by the LDCF (USD 3.4 million), with co-financing from the Royal Government of Bhutan, UNDP, the Austrian Development Agency and WWF-Bhutan. Bhutan revised its NAPA in 2012 and identified eight priority projects including disaster risk reduction and management. The Department of Geology and Mines has initiated numerous structural measures to reduce the possibility of future GLOF incidents such as draining of lake levels, installation of early warning systems and building river protection embankments.

Photo 26: Artifical lowering of Lake Thothormi

Photo Credit: DGM, MOEA

4.1.4 Sea Level Rising

Mean sea level rise is a gradual process. It is caused by ocean thermal expansion and by melting glaciers and ice sheets. The phenomenon of global warming exacerbates the process. Globally, the rate of sea level rise since the 1850s has been larger than the average rate during the previous 2,000 years. However, it varies with regions. A rate of sea-level rise of 3.1 mm/year has been reported over the past decade as compared to 1.7 to 2.4 mm/year 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 (UNEP and DA 2009). Changes of sea level in the Indian Ocean have emerged since the 1960s, driven by changing wind patterns (CDKN 2014). In Bangaldesh, the observed sea level rise has shown an increasing trend over the period 1947-2003. At the South-East of Bangladesh, the sea level rise was 1.4 mm/year, and in the south central part nearest to the sea, it was up to 3.9 mm/year (MoEF 2012).

The current and the projected increase in sea level rise could result in the flooding of low-lying coastal areas of South Asia like Bangladesh and India. Apart from coastal inundation, other consequences of climate change include increased salinization of surface and groundwater and loss of wetlands. Salinization also affects the crop productivity in the region. In an average year, salinity not only causes a net reduction of about 0.2 million tonnes of rice production, but also diminishes potentials of boro and wheat cultivation in saline affected soils of the coastal areas in Bangladesh (MoEF 2012).

4.1.5 Impacts on Agriculture

Climate change is likely to affect the crop yields in various regions of the world (Lobell *et al.* 2008). The issue of food security will be further compounded in the region due to the increased demand for food along with climate change. Erratic rainfall, extreme climatic events, temperature rise and emissions of greenhouse gases will also affect the crop productivity. Afghanistan, Bangladesh, India and Nepal are especially vulnerable to the reduced crop yields due to climate change. Reduced crop yields will have impacts on crop prices, worsening poverty in the region. The floods of 2010 resulted in agricultural and livestock losses of over USD 5 billion in Pakistan. More than 2.1 Million hectares of farmland was damaged destroying rice, cotton and sugarcane crops. Furthermore, more than 100,000 farm animals were lost and about 3,000 fish farms and 2,000 poultry farms destroyed. Drought conditions in Bangladesh in 1990s led to a loss of 3.5 million tonnes of rice production (MoEF 2012).

4.1.6 Impacts on Hydrology and Water Resources

Climate change would further aggravate the situation with water resources already under stress in the region due to the growing water demands of the population. The amount of water flows in the river systems are likely to change due to climate change. Melting of glaciers in the Himalayan region would adversely affect a large number of people who depend on glaciers for their water supplies. Initially, the river run-off will increase. However, in due course the run-off will decrease due to the loss of ice resources. This will have implications not only on the irrigation requirements for agriculture, but also on various other sectors. The abrupt increase in water quantity in rivers due to glacier melt would also lead to floods in the region.

One of the most pressing issues in the region would be the expansion of areas under water stress. This can be illustrated by the situation in India. It is expected that the gross per capita water availability of the country will decline to 1,140 m^3/year in 2050, which is a decline from the availability of 1,820 m^3/year in 2001 (Gupta and Deshpande 2004). Increasing sea levels due to global warming also augment the risk of salt water intrusion into groundwater and surface water resources.

4.1.7 Impact on Biodiversity

The impact of global warming and climate change on biodiversity is emerging as a significant area of research. Climate change leads to ecosystem changes such as

phenological shifts, altitudinal and latitudinal range shifts and upward migration of species, colonization by new species, extinction of certain species, epidermis burning of vegetation, shifts in species occurrence and habitat changes for plants, birds and mammals and upward shift of cultivation and grazing activities. According to the AR4 (IPCC 2007), up to 30 percent of the higher plant and animal species are likely to be facing an increased risk of extinction if the global average temperature increase exceeds 1.5 to 2.5 over the present temperature.

The evidence of climate-related biodiversity loss remains limited in the whole of Asia. However, the movement of plant and animal species to higher latitudes and altitudes, as a result of climate change, has been observed in Asia (IUCN 2003). Sunderbans is under immense threat due to the intrusion of saline water. Sea level rise in the region may also threaten a wide range of mammals, birds, amphibians, reptiles and crustaceans. A study by WWF and Wangchuck Centennial Park (2011) on the vulnerability in Wangchuck Centennial Park in Bhutan indicates considerable loss of habitats for the snow leopard in the future climate scenario. Changes in number of animal species across eco-floristic zones have been reported in Bhutan. Increase in the population of animals such as blue sheep, wild boar, snow leopard and birds such as laughing thrush, blood pheasant and monal pheasant have been observed. Some of the animals observed to decline in population were the musk deer, barking deer, wild fox, leopard and tiger, and birds such as the eagle, hornbill, cuckoo, vulture and common crow etc. However, these changes are not necessarily due to climate change. In terms of plants, changes in flowering time across the different eco-floristic zones has been reported with *Rhododendron sp., Magnoliasp., Rosa sp., Juglans sp., Populus sp., Michelia doltsopa, Prunus sp., Erythrina sp., Daubanga sp.,Bombax sp.,* all flowering earlier (up to a month) compared to 10 to 20 years ago. Increase in the diversity of invasive species has also been reported (NEC 2011).

The effects of climate change on coral reefs are simply devastating. Diverse coral reefs of South Asia were lost in 1998, particularly due to the coral-bleaching event induced by the 1997/98 El Nino event (Wilkinson 2000; 2002).

4.1.7 Impact on Human Health

Health risks to humans are associated with increase in temperatures and heat waves. 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 state of Andhra Pradesh, Odisha and elsewhere during the past five years.

Other indirect health risks include diarrhoeal and other infectious diseases, which stem from flooding, ENSO-related droughts, sea-surface temperatures and rainfall in association with other non-climatic factors like poverty and lack of access to safe drinking water and poor sewerage system (Durkin *et al.* 1993; Akhtar and McMichael, 1996; Bouma and van der Kaay, 1996). Also, the distribution of vector species is altered by climate change, which may lead to the spread of diseases to new areas with poor public health infrastructure. There have been five dengue outbreaks associated with ENSO events in the year 1979, 1983, 1988, 1998 and 2005 in Maldives (Ministry of Environment and Energy 2011).

Other indirect health impacts can be measured in terms of deterioration in nutritional health, arising from crop failures caused by droughts (and high night temperatures) reducing the cereal yields.

4.1.8 National Adaptation Measures

Afghanistan

The Government of Afghanistan has paid considerable attention to the environmental issues of the country, especially climate change. The National Environment Protection Agency (NEPA) was established with a goal to "protect the environmental integrity of Afghanistan and support sustainable development of its natural resources through the provision of effective environmental policies, regulatory frameworks and management services that are also in line with the Afghanistan Millennium Development Goals (MDGs)". It's a signatory to the United Nations Framework Convention on Climate Change. With the technical support from UNEP and GEF, the National Adaptation Programme of Action for Climate Change (NAPA) came into existence. The objective of the NAPA is to serve as a simplified and direct channel of communication for information relating to the urgent and immediate adaptation needs of Afghanistan to the effects of climate change. Improved water management and efficiency of use, and land and water management at the watershed level are the prioritized areas. Other priorities include agro-meteorological observations, horticulture and agro-forestry, adaptive rangeland management, and terracing and erosion control.

Bangladesh

Climate Change Cells (CCCs) were introduced in relevant ministries by the Government of Bangladesh to mainstream climate change issues in developmental activities. In the year 2010, a Climate Change Unit was established in the Ministry of Environment and Forests to facilitate and coordinate with the CCCs and manage climate change funds. The National Adaptation Programme of Action (NAPA) was completed in 2005 and further updated in 2009. In 2008, the government adopted the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), focusing on six priorities: food security, social protection and health; comprehensive disaster management; infrastructure development; research and knowledge management; mitigation and low-carbon development; and capacity building and institutional strengthening. A Climate Change Trust Fund, with an allocation of US $100 million for the fiscal year 2009-2010 and another US $100 million for the fiscal year 2010-2011, and the Bangladesh Climate Change Resilience Fund (BCCRF) with commitments of £60 million from the United Kingdom, €8.5 million from the European Union, and DKK10 million from Denmark, have also been set up.

Bhutan

Bhutan completed its National Adaptation Programme of Action in 2006. After the emergence of other climate risks and vulnerabilities, the government of Bhutan revised its NAPA in 2012 and identified eight different priority projects. These projects include disaster risk reduction, landslide management and flood prevention, climate resilient and environment friendly road construction and others. The high level commission members of the National Environment Commission (NEC) form the National Climate Change Committee. Bhutan's policy guidelines of 'Vision 2020' and 'Good Government Plus' emphasize ramping up climate change mitigation by developing hydropower and solar energy resources. Bhutan has prepared a National Action and Strategy Plan for Low Carbon Development in 2012. Low carbon development has been mainstreamed in all the sectors in the 11th FYP. Bhutan has also committed to phase out 100 percent CFCs and other Ozone depleting substances by 2025.

The UN Capital Development Fund (UNCDF) is active in Bhutan. It is helping the local communities to respond to the challenges of climate change. In July 2011, the Royal Government of Bhutan signed an agreement with UNCDF to pilot its Local Climate Adaptive Living Facility (LOCAL). LOCAL increases climate change adaptation financing while strengthening the capacity of local governments and of the local climate change adaptation planning process through a system of performance-based grants. The pilot targets two village groups (Gangtey and Nangkor) within two municipalities (Wangdue and Zhemgang, respectively) as well as the Phobjica valley, a critical habitat for the endangered black-necked crane.

India

The landmark precedence was the National Action Plan on Climate Change (NAPCC) in 2008, by the Prime Minister's Council on Climate Change for climate change action in the country. The NAPCC consists of eight national level missions, of which five pertain to adaptation. These are- National Water Mission, National Mission on Sustainable Agriculture, National Mission for Green India, National Mission for Strategic Knowledge and National Mission for Sustaining the Himalayan Ecosystem.

To integrate climate action at sub-national levels, various states were also directed to develop their own action plans under the framework of the NAPCC.

The Planning Commission of India is making efforts at the national level to integrate climate change concerns in development planning. Keeping these concerns in mind, the Steering Committee on Environment, Forests and Wildlife and Animal Welfare for the Twelfth Five Year Plan of the Planning Commission formed a Sub-Group on Climate Change (as part of the Working Group on Environment and Climate Change) in July 2011. The working group studied the vulnerability of various sectors to climate change and made recommendations on climate change for the Twelfth Five Year Plan, based on review of the existing programmes, policies and initiatives taken for adaptation and mitigation, including regulatory mechanism, research and development, infrastructure and institutional mechanism.
The Twelfth Five Year Plan emphasises on adapting agricultural practices to the climatic conditions, and managing water resources comprehensively and efficiently. The plan suggests that all levels of Government need to act together to combat the challenge of climate change. Apart from certain schemes and above-mentioned initiatives that can be considered important for adaptation, the only communication on climate change at the national level that reaches the grassroots is through civil society organizations and indirectly through schemes that address measures for climate change adaptation.

Table 21: Recent Initiatives of Climate Change in India

Area	Initiative/ Event	Contribution
Science and Research	Indian Network for Climate Change Assessment (INCCA)	Network of 120 research institutions and 250 scientists launched on October 14, 2009.
	Himalayan Glaciers Monitoring Programme	Comprehensive programme to scientifically monitor the Himalayan glaciers – Phase I completed; Phase II launched; Discussion Paper on State of Himalayan Glaciers released
	Launch of Indian Satellite to Monitor Greenhouse Gases	ISRO to launch a satellite to monitor the greenhouse gases and their impact on climate change.
Policy Development	Expert Group on Low Carbon Economy	Planning Commission-led Group set up to develop strategy for India as a low carbon economy; to feed into the Twelfth Plan process.
	National Policy on Bio-fuels	National Policy on Bio-fuels approved by Cabinet to promote cultivation, production and use of Bio-fuels for transport and in other applications.
Policy Implementation	National Missions under National Action Plan on Climate Change	National Missions on Solar Energy, Energy Efficiency and Strategic Knowledge approved; other Missions in final stages of preparation.
	First National Conference on Green Building- Materials and Technologies	Conference to stimulate green building sector; to set an example the Govt proposes that all its new buildings will be GRIHA compliant, subject to site conditions.
	30 "Solar Cities"	In-principle approval given to 30 'Solar Cities' with aim at 10 percent deduction in projected demand of conventional energy through a combination of energy efficiency and renewables.
	Energy Efficiency Standards for Appliances	Energy efficiency ratings made mandatory for four key appliances — refrigerators, air conditioners, tube lights and transformers from January 7, 2010; more to follow through 2010.
	Fuel Efficiency Norms	Plan for fuel economy norms for vehicles announced; to be made operational in two years.
	CDM Programme	India assessed as Best CDM Country; Indian projects to neutralize 10 percent of emissions by 2012.
International Cooperation	India hosted Rio+20	India hosted the 11th COP of Convention on Biodiversity (CBD) in 2012, to mark 20th anniversary of Rio.
	UN Climate Technology Conference	India successfully hosted the Global Conference on Technology, Delhi Statement adopted.
	SAARC Environment Ministers Conference	India successfully hosted SAARC Ministers Conference and agreed joint actions on Climate Change.
	India's Submissions to UNFCCC	Report documenting India's 12 proactive submissions to UNFCCC released.
Forestry	State of Forests Report 2011	Latest SFR released.
	Launch of CAMPA	Ambitious Rs 11,700 Crore (USD2.5Bn) Programme for forest conservation launched.
	Capacity Building in Forestry Scheme	New Rs 369 Crore (USD 80Mn) scheme for HRD for forest personnel.
	Inclusion of Forestry with NREGA	Forestry-related activities included as a part of India's flagship employment guarantee scheme to fast-track reforestation; Pilots being implemented.

Source: MoEF&CC (2010)

Maldives

The Republic of Maldives, with its small island states, is one of the most vulnerable countries to climate change impacts, especially the sea level rise, ocean acidification and increased storm severity and frequency. With more than half the settlements and most of the critical infrastructure of the Maldives within 100 metres of the coast, there is serious concern about projections that 85 per cent of the country could be below the sea level by 2100 (Khan *et al.* 2002). Recognizing this threat, Maldives was the first country to declare its intention to be carbon neutral by 2019 (UNEP 2009) and to view climate change as a critical national development challenge. In response, the Seventh National Development Plan adopted a policy of identifying ten safer islands, future refuges for people displaced as a result of climate change. This policy includes high-cost infrastructure such as sea walls and desalination plants, and even artificial islands such as Hulhumale in Male Atoll. The government has also implemented a softer set of policy measures under the Integrating Climate Change Risks into Resilient Island Planning in the Maldives programme (GEF 2009), which involves working with nature to increase resilience, including coastal afforestation, replenishing natural ridges, climate-proofing drainage, coral reef propagation, mangrove planting and beach nourishment. Each island community is involved in choosing the most appropriate measures.

The main adaptation initiatives for implementation are summarized below:

- Use of Locally Appropriate Technologies: Appropriate adaptation measures for flooding and erosion are to be demonstrated initially in four islands in four different atolls. It is aimed to make 50percent of the households in four islands and ten percent of the population in each of the four atolls better protected from climate change impacts. This programme will be later replicated in the entire country.
- Sustainable Land Management: Climate risk reduction measures are to be integrated into the national policies on environment, land use, decentralization, privatization and disaster risk reduction. This programme aims at technical capacity building in the form of training to the staff at national, atoll and island levels and farms and local community in the aspects of land management, agricultural best practices and workshops and consultation with communities to increase the understanding of land degradation.
- Sustainable Water Management: An integrated water resource management programme is being developed. To increase the resilience of the country through freshwater management, Mahibadhoo (*Alifu Dhaalu atoll*), Ihavandhoo (*Haa Alifu atoll*) and Gadhdhoo (*Gaaf Dhaal atoll*), representing different geographical locations of the county and having a flat topography varying between 0-0.5m MSL, have been selected.
- Strengthening the Information Base: To address the data gaps on the effects of climate change in the country, a climate risk information system (linked to National GIS) is going to be established. This will provide universal access to different datasets for adaptive planning.

Nepal

The Ministry of Environment of Nepal serves as the focal ministry for climate change related activities and has established a climate change management division. A multi-stakeholder Climate Change Initiatives Coordination Committee was established in April 2009 to foster a unified and coordinated climate change response. Nepal launched a three-year interim sustainable development plan (2007-2010) that focused on improving environmental management and sustainable natural resource use, with the aim of maintaining a 39.6 percent forest cover. The plan also included upgrading the country's water infrastructure and weather forecasting facilities, and developing the Clean Development Mechanism-eligible renewable energy and community forestry projects. Nepal also initiated its NAPA in 2010.

Pakistan

The Ministry of Climate Change of Pakistan (now Climate Change Division) launched its National Climate Change Policy in 2012. The aim of the policy is to mainstream climate change in the economically and socially vulnerable sectors of the community. It provides a framework for coping with the threats of climate change through adaptation and mitigation measures. The policy focuses on development sectors such as water resources, agriculture and livestock, forestry, human health, disaster preparedness, transport and energy.

Sri Lanka

The Sri Lankan government's National Action Plan for the *Haritha* (Green) *Lanka Programme* provides a framework

for environmental issues and programmes, including climate change. Its mission is to focus on addressing critical issues which, if left unattended, would jeopardize the nation's economic development programme. A specific section is dedicated to dealing with climate change and references policies and actions to counter its impacts by developing renewable energy resources, energy efficiencies, carbon sequestration, waste management, infrastructure vulnerabilities, zoning, rainwater harvesting, and adaptation measures to increasing vectors and food security measures. Apart from these policy documents and action plans, the government has also strengthened the institutional base. Units like the Centre for Climate Change Studies at the Meteorology department, the National Ozone Unit, the National Cleaner Production Centre, the Biodiversity Secretariat as well as expert committees on land degradation and droughts and biodiversity have been established.

Box 18: Mountain Initiative for Climate Change Adaptation in Mountain Regions

The Mountain Initiative for Climate Change Adaptation in Mountain Regions was initiated by the Government of Nepal to bring the mountainous countries together and build a common platform to support the Mountain Agenda. The Mountain Initiative provides a framework within which mountain countries, in collaboration with specialized global and regional agencies, can work together for greater recognition of the critical role of mountain ecosystems in the context of global climate change. It highlights the need to better advocate for mountain ecosystems based on state-of-the-art knowledge so that mountain people can be supported more effectively in their struggle to adapt to the new challenges, and enabled to benefit from emerging opportunities. The International Centre for Integrated Mountain Development (ICIMOD) is providing technical support and backstopping to the governments in the region in this initiative led by the Government of Nepal, and especially to the Ministry of Environment.

Source: Mountain Initiative Status Paper, ICIMOD

4.1.9 Mitigation Measures

Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets. It was adopted in Kyoto, Japan, on 11 December, 1997 and entered into force on 16 February, 2005. Its first commitment period commenced in 2008 and ended in 2012. Parties to the Kyoto Protocol adopted an amendment to the Kyoto Protocol by decision 1/CMP.8 in accordance with Articles 20 and 21 of the Kyoto Protocol, at the eighth session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol held in Doha, Qatar, in December 2012. During the second commitment period, Parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period from 2013 to 2020.

Countries with commitments under the Kyoto Protocol to limit or reduce greenhouse gas emissions must meet their targets primarily through national measures. As an additional means of meeting these targets, the Kyoto Protocol introduced the concept of carbon markets.

The Kyoto mechanisms are:

- Emission Trading
- Clean Development Mechanism (CDM)
- Joint Implementation (JI)

CDM enables public or private sector entities in developed countries (Annex I) to invest in GHG mitigation projects in developing countries. In return, the investing parties receive credits or certified emission reductions (CERs) which they can use to meet their targets under the Kyoto Protocol.

Box 19: Delhi Metro: First Metro in the World to Earn Carbon Credits

The Delhi Metro Rail Corporation has been certified by the UN as the First Metro Rail and Rail based system in the world to get carbon Credits for reducing Green House Gas Emissions as it has helped to reduce pollution levels in the city by 6.3 lakh tonnes every year, thus helping in reducing global warming. DMRC has helped in reduction in emission of harmful gases into the city's atmosphere and the United Nations Body administering the CDM under the Kyoto Protocol has certified that DMRC has reduced Emissions and thus earned carbon credits worth about Rs. 47 crore annually for the next seven years and this figure shall increase with the increase in the number of passengers.

Source: www.delhimetrorail.com

Table 22: Registered CDM Projects in the Region

Countries	Registered CDM Projects
Bangladesh	• Landfill gas extraction and utilization at the Matuail landfill site, Dhaka, Bangladesh • Composting of organic waste in Dhaka • Improving kiln efficiency in the brick making industry in Bangladesh (Bundle-1) • Improving kiln efficiency in the brick making industry in Bangladesh (Bundle-2)
Bhutan	• Bhutan micro hydro-power CDM project • Dagachhu hydro-power project
India	• 13.75 MW wind power project at Bellary and Davangere district, Karnataka • KL Rathi steels 4.5 MW wind power project at Jaisalmer district, Rajasthan • 3.2 MW wind power project in Gujarat by Rajlakshmi Minerals • Biomass based thermal energy generation at Swastik Refinery, West Bengal • 10.5 MW wind power project in Ossiya, Rajasthan by Gujarat Fluoro-chemicals Ltd. • Solar PV power project by DMPL in Fatepur, Gujarat • 8 MW biomass power plant at Kishanganj, Baran district, Rajasthan • Tadas wind farm in Karnataka In total, there are 1254 registered CDM projects in India.
Nepal	• Biogas support programme • Efficient fuel wood cooking stoves project in the foothills and plains of the Central region of Nepal • Micro-hydro promotion
Pakistan	• Waste heat recovery and utilization of power generation at Maple Leaf Cement Factory Limited, Iskanderabad, Pakistan • Yunus Energy Limited 50 MW wind farm project • Patrind hydropower project • Biomass based cogeneration in Engro Foods Supply Chain Pvt Ltd IRPC, Muridke, Pakistan There are a total of 26 projects registered in Pakistan
Sri Lanka	• Mampuri wind power project • Grid connected hydropower project • Adavikanda, Kuruwita division, mini hydro-power project • Coconut shell charcoaling and power generation at Badalgama Apart from these, there are four other hydro-power projects.

Source: cdm.unfccc.int

Developing countries that are party to Kyoto Protocol can finance adaptation projects through the Adaptation Fund. The Adaptation Fund is financed with a share of proceeds from the CDM project activities and other sources of funding. The share of proceeds amounts to 2 percent of CERs issued for a CDM project activity. Over the past three years, the fund has dedicated more than USD 226 million to increase climate resilience in 39 countries around the

world. Some of the projects approved for funding in the South Asian region are mentioned below:

Table 23: Approved Projects under Adaptation Fund

Countries	Projects title	Approved Amount (USD)
Sri Lanka	Addressing Climate Change Impacts on Marginalized Agricultural Communities Living in the Mahaweli River Basin of Sri Lanka	7,989,727
Maldives	Increasing climate resilience through an Integrated Water Resource Management Programme in HA. Ihavandhoo, ADh. Mahibadhoo and GDh. Gadhdhoo Island	8,989,225
Pakistan	Reducing Risks and Vulnerabilities from Glacier Lake Outburst Floods in Northern Pakistan	3,906,000

Source: www.adaptation-fund.org

Clean Technology Initiatives

There is substantial need for the promotion of clean technologies in the region in the present scenario to address localized environmental problems and reduce the emission of greenhouse gases. The Clean Technology Fund (CTF) provides middle income countries with resources to explore options to scale up the demonstration, deployment and transfer of low-carbon, clean technologies. The Ministry of Environment Forests and Climate Change, Government of India, has selected four sectors in the country to seek funding from World Bank and Asian Development Bank under CTF. These include funding for promoting hydropower in Himachal Pradesh; supporting the National Mission for Enhanced Energy Efficiency; providing partial risk guarantee for energy efficient technologies and support to the Jawaharlal Nehru National Solar Mission. On May 3, 2013 the GEF-UNIDO Cleantech Project, a collaborative project of the Federation of Indian Chambers of Commerce and Industry (FICCI), United Nations Industrial Development Organization (UNIDO) with the Ministry of Micro, Small and Medium Enterprises (MSME), was launched. The project will focus on building a roadmap for creating a Cleantech ecosystem in India through an interdisciplinary approach involving SME clusters, ministries, academia, industry associations, state governments, partner agencies and autonomous research centres globally and in other developing countries. The Cleantech Project will have a special focus on linking innovators to investors.

One of the important approaches of the Climate Change Strategy and Action Plan of Bangladesh is to ensure low carbon development through the transfer of state-of-art technologies from developed countries to follow a low-carbon growth path. The main programmes mentioned under this theme included improving energy efficiency in production and consumption of energy, gas exploration, development of coal mines and coal fired power stations, renewable energy development, lower emission from agricultural land, management of urban waste, afforestation and reforestation programme, rapid expansion of energy saving devices, energy and water efficiency in the built environment along with improvement in energy consumption pattern in the transport sector and discovering options for mitigation. A number of projects are also running in Bhutan to promote energy efficiency and partial replacement of fossil fuel power generation by hydropower.

4.1.7 Regional Cooperation

The Fourteenth SAARC Summit (New Delhi, 3-4 April 2007) expressed 'deep concern' over the global climate change. As a follow-up action, the New Delhi Declaration called for pursuing a climate resilient development in South Asia. SAARC Action Plan on Climate Change was adopted during the SAARC Ministerial Meeting on Climate Change on July 3, 2008 at Dhaka and later endorsed by the Fifth SAARC Summit on August 3, 2008 at Colombo. The action plan would seek to achieve the following objectives:

- To identify and create opportunities for activities achievable through regional cooperation and south-south support in terms of technology and knowledge transfer.
- To provide impetus for regional level action plan on climate change through national level activities.
- To support the global negotiation process of the UNFCCC such as the Bali Action Plan, through a common understanding or elaboration of the various negotiating issues to effectively reflect the concerns of SAARC Member States.

The thematic areas of the action plan include adaptation to climate change, policies and actions for climate change mitigation, policies and actions for technology transfer, finance and investment, education and awareness,

management of impacts and risks due to climate change and capacity building for international negotiations. This plan was initially proposed for a period of three years (2009-2011).

The Thimpu Statement on Climate Change in 2010 agreed to establish an inter-governmental expert group on climate change to develop clear policy direction and guidance for regional cooperation as envisaged in the SAARC Plan of Action on Climate Change. A few other initiatives were to commission a SAARC Inter-governmental Mountain Initiative, a Monsoon Initiative and a Climate-related Disasters Initiative on the integration of Climate Change Adaptation (CCA) with Disaster Risk Reduction (DRR).

Box 20: Regional Climate Change Adaptation Knowledge Platform (AKP)

AKP helps the developing countries of Asia to strengthen the adaptive capacity and facilitate the climate change adaptation at local, national and regional levels. It bridges the gap between researchers, policy makers, business leaders and those working on climate change adaptation "on the ground". It focuses on three main aspects:

- Establishing a regional system for sharing knowledge on climate change adaptation, making it easy to understand and also available to those who need it;
- Generating new knowledge about adaptation that national and regional policymakers can use as they plan for climate change; and
- Promoting the application of new and existing knowledge about climate change in Asia.

Apart from countries like China, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines and Vietnam, countries of South Asian region like Bhutan, Bangladesh, Nepal and Sri Lanka are also a part of AKP. It is supported by the Swedish International Development Cooperation Agency with the help of partners like Stockholm Environment Institute, the Swedish Environmental Secretariat for Asia, and the Asian Institute of Technology /UNEP Regional Resource Centre for Asia and the Pacific.

Source: www.unep.org

4.1.10 Recommendations

In order to address climate change, it is necessary to implement policies supporting carbon-neutrality, renewable energy and efficiency. The key measures include integrating climate change adaptation and disaster risk reduction, mainstreaming adaptation concerns into development policies and plans, ecosystem-based adaptation and developing climate-proofed infrastructure. However, before the adoption of any measures, it is necessary to demystify the concepts of climate change. Public awareness about the impacts of climate change should be enhanced. Media can play an important role in this aspect.

Assessment of Climate Change Impacts

Formulation of policies requires the support of credible scientific assessment of the impacts of climate change at different geographical locations. Vulnerability assessments should be conducted for this purpose. Simultaneously, the capacity of the countries should also be built to carry out these assessments.

Linking Development and Climate Change Issues

It is well-known that the impacts of climate change will exacerbate the development challenges of the region. Therefore, it is extremely crucial to formulate holistic policies that would address the climate change issues while meeting the development challenges. It is also vital to integrate climate change issues at the local level planning process.

Promoting Innovative Adaptation Measures

Adaptation is the process of adjustment to actual or expected climate and its effects. It is an effective option to manage the impacts of climate change. Effective adaptation strategies can strengthen livelihoods, enhance well being and human security and reduce poverty. 'No regrets' or 'low regrets' adaptation measures such as increasing access to information and resources, diversifying cropping systems, strengthening access to land, credit and other resources for poor and marginalised crops, making land and water management and governance more effective should be promoted. Such measures will not only help in combating climate change, but also help in the overall development of the region. Adaptation should be integrated into planning and decision making process.

Disaster Risk Reduction

Disaster risk reduction (DRR) is gaining importance in the present times as climate change is expected to result in more frequent extreme weather events. It should be priority for all the countries. They need to focus not only on relief measures but more on developing the resilience of communities. Disaster preparedness should be strengthened for effective response and recovery at all levels, from the local to the national.

Photo 27: Disaster Risk Reduction is Gaining Importance in the Current Times

Photo Credit: Nabin Baral, ICIMOD

Loss and Damage

Loss and damage refers to permanent loss due to impacts of climate change, including extreme weather events, sea level rise etc. In a short span of 11 months, India alone has witnessed the damage due to the devastating floods in the Himalayan state of Uttarakhand and the Phailin cyclone in Odisha. It is critical now to move beyond adaptation and mitigation efforts and address loss and damage as a standalone issue. It has been one of the hottest topics of debate at the Conference of Parties (COP-19) held in Warsaw, Poland in November 2013. After a lot of debate, an institutional mechanism for Loss and Damage was established at COP 19. However, this mechanism needs to be strengthened in terms of finances and compensatory mechanisms.

Sustainable Trade and Investment

Trade and investment are the engines of economic growth and development. However, the implications of trade on climate change are obvious. As trade and investment increased rapidly in the region, GHG emissions rose as well. On the other hand, trade and investment play a key role in mitigating climate change impacts as well. Through trade and investment, more efficient climate smart goods and technologies (CSGTs) can be developed, produced and disseminated in the region. Hence, sustainable trade and investment related policies are required to promote climate-friendly trade and investment. Focus should be policies that promote trade and investment in CSGTs and renewable energy technologies. Trade in carbon intensive goods and services should be discouraged through environmental laws and regulations rather than trade policies. However, trade policies should promote CSGTs and other climate-smart services. Liberalization of CSGTs should also be done. It can take place through regional and bilateral trade agreements. For example: the South Asia Free Trade Agreement (SAFTA) covers the aspect of CSGTs. Climate smart FDI should also be pursued as it has high potential to transfer capital, technology and expertise for climate-smart growth and development.

Greening of Fiscal Policies

Innovative financing needs to be implemented including carbon tax, emissions trading, feed-in tariffs and REDD+ (Reducing Emissions from Deforestation and Forest Degradation). Carbon tax helps in bringing about a behavioural change in the producers and consumers towards the adoption of climate-smart goods. Such a shift would help alter the economic incentive structure in favour of environment-friendlyactivities. Revenue earned from carbon tax should be used in the development and promotion of climate smart goods. Apart from taxes, other financial instruments can also be deployed to support climate-smart development like low-cost loans by development banks, green bonds and risk insurance and guarantee (UNESCAP 2011).

Civil Society Participation in Policy Making Process

The role of civil society and other non-state actors should not be limited to inputs for policy making. A participatory policy making process should be evolved to involve the civil society from the start. An institutional framework should be developed as a part of policy making process to ensure appropriate representation of civil society.

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4.2 Water Security

In the present scenario, where development has to go hand-in-hand with environment and simultaneously ensure basic human rights like access to food, water and shelter, water has outcropped as a major concern globally. Concerns vary significantly region-wise in magnitude. South Asian region, owing to its location and varied topography and demography, depicts new emerging issues along with an increase in the existing issues related to water security. Many South Asian countries are experiencing severe water scarcity brought on by cumulative effects of increase in agriculture, industrialization, urbanization and population. Apart from these, there are other issues like pollution, politicization of water resources, changes in rainfall pattern, receding glaciers and other bio-physical vulnerabilities. There is an imminent threat to the freshwater resources, including perennial rivers like the Ganges, Indus and Brahmaputra.

4.2.1 Issues and Pressures

When it comes to accounting for water security, it is vital to account for the population concerned, considering the future population scenario. South Asia is home to one-fourth of the world's population, including some of the world's poorest people, having access to less than five per cent of the planet's freshwater resources, according to the UNEP.

The growing irrigation requirement is a major concern for the South Asian countries like India, Pakistan, Sri Lanka and others. The pressure on water resources for irrigation purposes is estimated at 52 percent in South Asia (FAO 2011). The dependence on groundwater resources is continuously rising, as they are easily accessible and of high quality and (as a consequence) are being depleted at an alarming rate. In fact, saline groundwater and increased fluoride content is a consequence of over-exploitation of groundwater and reduction in water table, as is evident in central India where contamination due to aquifer-intrinsic properties is taking place because of the over-exploitation of the existing water resources.

Rapid Industrialization

Rapid industrial growth and migration of people from rural to urban areas in the present era of technological advancement is threatening the ecosystems involved. South Asia is primarily an agrarian economy. However, increasing industrialization has increased the pressure on freshwater sources due to increased water demands in urban industrial areas, for industrial processed food and increasing demand for electricity.

Forest and Land Degradation

Deforestation and land degradation are vital factors impacting the water availability. Land degradation reduces the capacity of soil to hold water, whereas deforestation leads to changes in the rainfall pattern, reduces groundwater recharge, increases the run-off and degrades the soil. The cumulative impact of all this is decreased water availability, soil degradation and loss of vegetative cover. Hence, the water table continuously falls. As many developing countries are moving towards industrialization and urbanization, deforestation is taking place at a devastating pace to meet the land requirements.

Pollution

Rapid economic development, industrial growth, development of more and more urban set ups, changes in agricultural practices and even climate change have resulted in pollution of the available freshwater. This is a threat to our goal of water security. Most countries conveniently follow the practice of disposing sewage waste and waste water in their rivers and lakes, thus polluting them. Eutrophication of lakes and other water bodies causes NPK accumulation. Increasing use of pesticides and fertilizers also play a major role in polluting the water bodies. Disposal of a large amount of hazardous and industrial waste in water is a grave issue. In fact, this toxic waste further leaches down to the aquifers and pollutes the groundwater, which (if polluted once) is very difficult to remediate.

Photo 28: Discarding Waste into River, a Source of Water Pollution

Photo Credit: Tshering Tashi

The degrading water quality can be seen in many parts of South Asia. All the major 14 rivers of India are highly polluted. In Bangladesh, water quality has deteriorated in some locations as a result of pollution from agro-chemicals, industrial wastes and wastes from other sources; and, even arsenic contamination of groundwater has been reported in many documents. Groundwater extraction has increased tremendously in Maldives, mostly due to tourism. In Pakistan, indiscriminate disposal of effluents (including agricultural drainage water, municipal and industrial wastewater) into rivers, canals and drains is causing deterioration in water quality in the downstream Indus River (FAO 2011). The groundwater is marginal to brackish in 60 percent of the aquifers of the Indus Basin Irrigation System (IBIS).On the other hand, excessive concentrations of iron and nitrates (from agro-chemicals and fertilizers) have been reported in some parts of Sri Lanka (northern and north-western coastal areas).

Water and Climate Change

Climate change has significant impacts on the global and regional hydrological cycles. Impacts of climate change are manifested in the form of changing precipitation patterns, increased intensity of extreme weather events, glacial melt and more intense drought in semi-arid regions.

With the increase in global warming and changing climatic patterns, there have been variations in rainfall all over the Indian Subcontinent and hence increased instances of flood and drought. With these changes, there have been disruptions in the hydrological cycle of the region along with the depletion of the overall water resources. Potential impacts of global warming on water resources include enhanced evaporation, geographical changes in precipitation intensity, duration and frequency (together affecting the average run-off), soil moisture, and the frequency and severity of droughts and floods.

South Asian countries are facing a high risk of droughts and floods that vary in intensity, duration and spatial coverage; climate change has further exacerbated this situation. The western parts of the Indian sub-continent, including the deserts in Punjab, Thar Desert in Pakistan, Rajaputna desert and Gujarat State of India, are considered drought-prone. Floods have been experienced in India, Pakistan, Bangladesh, Nepal and Sri Lanka, some of which have been devastating. About 60 percent of the landmass of Bangladesh is considered flood-prone and around 25 percent is flooded every year. In fact, an increase in extreme flood events has been experienced in the recent years in Bangladesh.

Water, energy and climate change are interdependent issues. Increase in the human population and economic development would augment energy demands. Increasing use of fossil fuels would add to the GHG emissions, contributing to the climate change. In fact, climate change would have an adverse impact on water security. On the other hand, water scarcity would also hamper electricity production. The most water-intensive form of electricity production is biomass, followed by hydropower, oil, coal and nuclear, gas, some concentrated solar power systems and geothermal, solar photovoltaic, and wind. Many forms of solar power also require significant quantities of water for cooling purposes. More than half of the existing or planned capacities for major power companies are located in the water-stressed regions of South Asia (UNEP 2012).

4.2.2 Freshwater: A concern

Given the issues related to water, like population and urbanization, there is an increasing pressure on freshwater sources like lakes, rivers, groundwater and they are getting depleted at a very fast rate. Management of freshwater basin is a growing concern as only 0.3 percent of the total 2.5 percent freshwater is in the form of lakes and rivers. Problems related to freshwater, like river pollution, eutrophication of lakes and reservoirs, waste water and storm water, sewage and public health problems, pose a serious threat to water security. This has further increased the pressure on fisheries as the deteriorated water quality affects the health of the marine life.

The National Water Security Index is built around five key dimensions: household water security, economic water security, urban water security, environmental water security and resilience to water-related disasters.

Table 24: Framework for Assessing National Water Security

Index	What the Index Measures
Household Water Security	To what extent, countries are satisfying their household water and sanitation needs and improving hygiene for public health
Economic Water Security	The productive use of water to sustain economic growth in food production, industry, and energy
Urban Water Security	Progress toward better urban water services and management to develop vibrant, livable cities and towns
Environmental Water Security	How well river basins are being developed and managed to sustain ecosystem services
Resilience to Water-related Disasters	The capacity to cope with and recover from the impacts of water-related disasters

Source: ADB (2013)

ADB assessed the water security of a number of countries, measured on a scale of 1-5. The description of the various stages of national water security is depicted below.

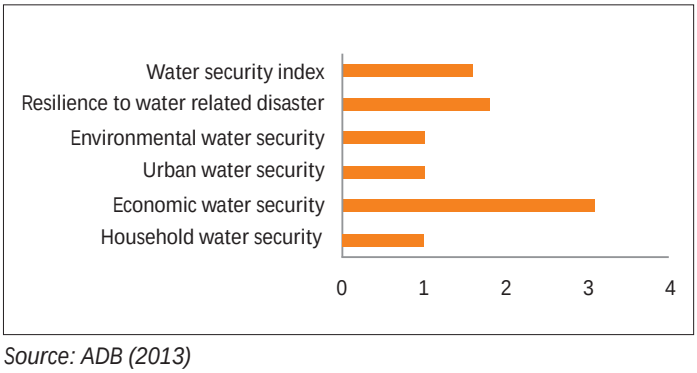
Table 25: Description of National Water Security Stages

National Water Security Index	National Water Security Stage	Description
5	Model	Sustainable local agencies and services; sustained sources of public financing for water and environmental protection and management; sustainable levels of public water consumption; and government demonstrating new models of water governance, supporting advanced technology. Supporting research and development, and initiating or leading international partnerships
4	Effective	Water security initiatives built into key national, urban, basin and rural development master plans; high priority on national development agenda; public investment reaching appropriate levels; effective regulation; and public awareness and behavioural change are a government priority.
3	Capable	Continuous capacity building: improving rates of public investment; stronger regulation and enforcement; national development agenda prioritizing water and environments; and focus shifting toward improving local technical and financial capacity
2	Engaged	Legislation and policy supported by government capacity-building programmes; institutional arrangements improving and levels of public investment increasing (although these rates may still be inadequate)
1	Hazardous	Some legislation and policy on water and environment; and inadequate levels of public investment, regulations and enforcement

Source: ADB (2013)

The Water Security Index shows South Asia (Water Security Index = 1.6) as a hot spot, where populations and economies are being adversely impacted by poor water security. South Asia is less secure than other regions in Asia Pacific in terms of its household water security (including sanitation), urban water security, environmental water security, and resilience to water-related disasters. South Asia is slightly more secure in its economic water security than Central and West Asia.

Figure 34: Water Security Index of South Asia



Source: ADB (2013)

4.2.3 Water Security and Human Health

Access to Drinking Water and Sanitation

Globally, over two billion people have gained access to improved water sources from 1990-2010. The proportion of population still using unimproved water sources is

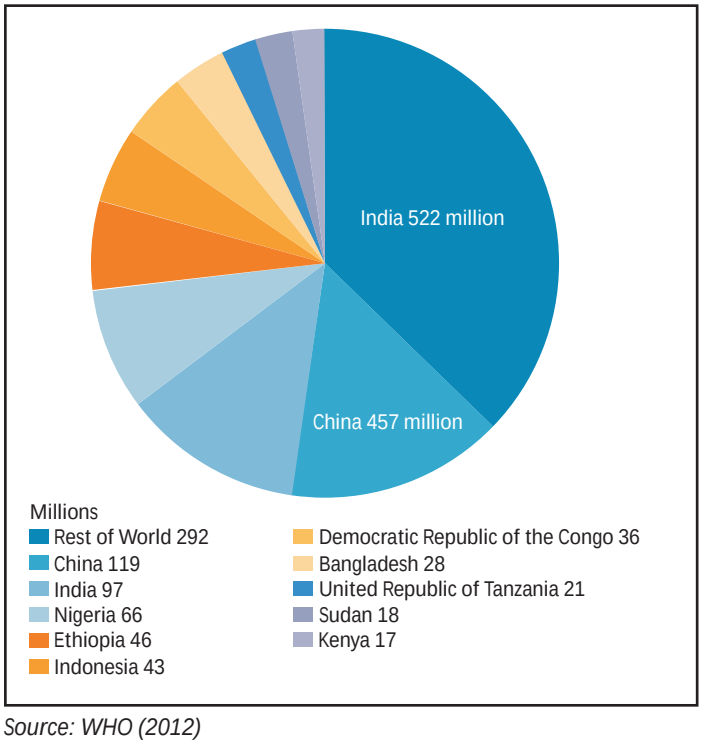
estimated to be around 11 percent. The total coverage of improved water sources in developing countries is 86 percent. Statistics reveal that 679 million people in South Asia have gained access to drinking water, India being the major contributor with 522 million people.

People in South Asia don't depend on piped water resources on their premises. Around 65 percent of the population is using other improved sources like bore wells, rainwater, tanker trucks and surface water etc. rather than the piped water.

Even though much progress has not been witnessed in Afghanistan, it is still remarkable in terms of the people served. Though it has provided improved water resources to only about 19 percent of the population; still, it represents around 15 million people.

Despite their progress in the last two decades, India and Bangladesh still have 97 million and 28 million people without access to improved water services, respectively.

Figure 35: Ten Countries with the Largest Population without Access to Improved Water Sources (Population in Millions)



Source: WHO (2012)

Even though the sanitation coverage of South Asia has increased by 17 percent since 1990, the region is still struggling with low coverage at 41 percent. Four out of 10 people who have gained access to improved sanitation since 1990 reside in India or China. Out of the 399 million who have improved sanitation facilities, 251 million are in India.

The region is marked by the highest number of people who resort to open defecation. Although this number has decreased by 110 million since 1990, it is still practiced by 41 percent (692 million) of the population. Majority of the people practising open defecation live in rural areas. As a matter of fact, 55 percent of the rural population in the region practice open defecation. 59 percent of those practicing open defecation live in India.

Photo 29: 125 Million People don't have Access to Safe Drinking Water in India and Bangladesh

Photo Credit: South Asia Environment Outlook 2009

Water-related Diseases

Water-related diseases include those caused by micro-organisms and chemicals in drinking water; diseases like schistosomiasis, whose vector spends part of its life cycle in water; diseases like malaria with water-related vectors; and others such as legionellosis, carried by aerosols containing certain micro-organisms. According to the global health estimates of WHO, diarrhoeal diseases are responsible for approximately seven percent of the total mortality of South Asia (WHO 2011). These water-related diseases are a continuing public health problem in countries lacking access to adequate drinking water and sanitation.

In Bangladesh, some diseases and health hazards such as arsenicosis, blindness and physical disability occur as a result of arsenic toxicity to humans. In India, water-related diseases have continued to increase over the years in spite of government efforts to combat them. Certain States of India, such as Punjab, Haryana, Andhra Pradesh and Uttar Pradesh, are endemic to malaria because of the high

groundwater table, water logging and seepage into the canal catchment area. There are also numerous cases of filariasis. In Maldives, water-related diseases such as diarrhoea, cholera, shigella and typhoid started spreading as a result of poor sanitary conditions. In Pakistan, around 25 percent of all illnesses diagnosed at public hospitals and dispensaries are gastro-enteric in nature and 40 percent of all deaths (including 60 percent of infants' deaths) are caused by infections and parasitic diseases, most of them being water related. The most common diseases are diarrhoea, dysentery, typhoid, hepatitis, kidney stones, skin diseases and malaria.

4.2.4 Sea Water Intrusion and Salinization

The growing demand for freshwater in the coastal region has led to reckless groundwater pumping. This has caused sea water intrusion in the coastal freshwater aquifers and the upward diffusion of the deeper saline water in Bangladesh, India and Sri Lanka, which leads to the deterioration of groundwater quality. Also, along with anthropogenic factors, climate change has also contributed to the sea level rise which exacerbates the situation in the coastal regions. Use of this saline water has led to an upsurge in soil-salinity, which has a direct impact on agriculture. Also, this intrusion of salt water reduces freshwater availability in coastal regions. This is a serious threat to water security since a major portion of population in South Asia lives along the coast.

Table 26: Salinization in Irrigated Areas in Some Countries

Countries	Year	Area Salinized (Ha)
Bangladesh	1993	100,000
India	1998	3,300,000
Pakistan	2004	7,003,000

Source: FAO-AQUASTAT Database

4.2.5 Measures to Enhance Water Security

To ensure water security, environmental challenges of water resource development need to be addressed through efficient resource conservation practices, management strategies and efficient utilization, keeping in mind the ecological dynamics of the water resources. Considering the fact that with the burgeoning population, the overall demand for water is bound to increase. Hence, innovative approaches can serve as a good measure to face these challenges. In fact, small scale, need-driven technology can facilitate household access to safe and potable water.

More investment in water storage structures and treatment as well as reuse of water and waste water should be done to bring MDG back into the picture. As stated in the Rio+20 Outcome Document, it is evident that the flow of funds has decreased in the past decade. However, progress in terms of providing proper water and sanitation requires large investments from donors, participatory approach, capacity building, and innovative ideas for attaining water security.

Water Policies

Policy regulation is an appropriate measure to manage water resources for sustainable water security because it is the management of water resources where South Asia and many other parts of the world lack. The goal of water security can be certainly achieved with better management technologies and efficient policy changes.

Most countries have formulated National Water Policies, aiming to meet the growing need in all the sectors and develop them in a sustainable way. However in Bangladesh, no policy or Act pertaining to irrigation or water management has been formulated. Bhutan Water Policy came to the fore in 2005. In Pakistan, the Draft National Water Policy has been in the process of approval since 2005. In Sri Lanka, there are over 50 Acts of parliament concerning the water sector and laws that are administered by numerous agencies with a wide range of responsibilities, with numerous overlaps, gaps and conflicting jurisdictions. Nepal and India also have a number of Acts pertaining to water resource management.

Effective policies need to have strategic planning, keeping in mind the status of the nation per se in terms of its water resources. And, a set of explicit guidelines should be prepared as per the region-specific requirement that would include a participatory and consultative approach for the awareness of stakeholders. A proper legal framework for regulating withdrawals should be made especially for groundwater, policy regulation for well permissions, licensing, electricity restriction, along with pump installation restriction. This should be regulated so that excessive groundwater exploitation is prevented and problems like sea water intrusion, depleting water tables, salinization of the freshwater aquifers, and arsenic and fluoride contamination are nipped in the bud. Effective policy changes should be made, like building rainwater

harvesting structures in semi-arid and arid regions, especially to check those who are pumping groundwater.

The South Asia Water Initiative (SAWI) has sought to contribute to this mission by creating new knowledge (by generating information), supporting a unique multi-stakeholder platform (by promoting dialogue), and enabling innovative investments and institutional development (by facilitating action and investment). SAWI addressed key information challenges and made collaboration possible between the countries and filled data gaps and influenced policies, laws and regulations. It also promotes IWRM that aims at sustainable development of air, water and land to maximize social as well as economic benefits.

Trans-boundary Water Sharing

In South Asia, there exists a good number of trans-boundary rivers. In fact, India, Pakistan, Bhutan, Nepal, Bangladesh share 20 major rivers. Conflicts related to water-sharing arise now and then and pose a threat to the water security in these regions. The geographical and political disparities play a crucial role; a good relationship can benefit all the concerned parties, while a non-cooperative approach will lead to no one's benefit and aggravate the existing water-related problems as in the case of India-Nepal and Bangladesh over the GBM basin.

These river systems are major economic arteries as well as social and environmental assets for South Asia. Nearly 1.5 billion people are dependent on them, accounting for approximately half the population of South Asia.

To address the issue of trans-boundary water quality, the Cooperative Monitoring Centre (CMC) has initiated the South Asian Water Analysis Network (SAWAN). Four neighbouring countries (Nepal, India, Pakistan and Bangladesh) are participating in this programme to monitor trans-boundary river water quality of the Ganga Basin in the South Asian region. The major objectives of this programme are to promote co-operation in South Asia on environmental research, share regional information to build confidence, expand future co-operation and collect as well as share water quality information about rivers across the region.

Box 21: Participatory Water Management in Hiware Bazaar, India

Hiware Bazaar, located in Maharashtra, was a semi-arid village. Water scarcity was a major issue in the village as the water sources had dried up. Erratic rainfall worsened the situation. Apart from this, the village suffered from deforestation and land degradation. Only 12 percent of the land was cultivable in 1989-1990. Poverty and lack of employment opportunities led to large-scale migration of the population to cities. The village was also afflicted by social problems like addiction to alcohol and gambling.

In 1989, the village applied to the Adarsh Gaon Yojana (AGY) of the state government. In order to implement AGY, a five-year plan was developed. Water conservation was at the core of the development model. The Yashwant Krishi Gram and the Watershed Development Trust were instituted to implement the development works under AGY. They also banned cutting of trees and free grazing. In 1995, they also developed another five year plan for implementing the Employment Guarantee Scheme (EGS). This plan focused on ecological generation. An integrated plan was developed to streamline the work of all the departments involved in the implementation.

In order to the restore watershed, the village was divided into three micro-watersheds - the first with an area of 612.14 hectares, the second with an area of 123.4 hectares and the third with an area of 241.3 hectares. Major watershed works constructed were continuous contour trenching and tree plantation (on forest, private and panchayat land), contour bunding, nala (drain) bunding, percolation tanks and storage tanks. 40,000 contour trenches were built around the hills of this village to conserve rainwater and recharge groundwater. Plantation and regeneration activities were carried out by the villagers. Use of efficient irrigation systems like drip irrigation was encouraged. The use of groundwater was also minimized.

As a result of these activities, Hiware Bazaar transformed into an ideal village. The 70 hectares regenerated forest helped in treating the catchments; contour bunding stopped runoff and saved farms from silting, and around 660 water-harvesting structures caught rainwater. Poverty was also reduced by 73 percent. Since 2002, Hiware Bazaar has been doing an annual budgeting of water, where crops to be cultivated are decided on the basis of total amount of water available in the village is measured.

Source: Singh (2010)

Integrated and Participatory Water Management

Integrated Water Management is among the best approaches to manage and conserve water for all, maintain ecological balance, conserve water, and build resilience against climate change. Multi-stakeholder dialogue is essential to identify the issues and concerns and implement a holistic solution. Integrated watershed management and participatory approaches work at the village level, i.e. micro watershed level, and have been successful all over the world, with the focus on empowerment and training of communities to develop watersheds. India launched the Integrated Watershed Management Programme (IWMP) in 2009-10. The main objectives of the IWMP are to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water.

Photo 30: Involvement of Local Community for Watershed Management in India

Photo Credit: Development Alternatives

Improving Efficiency and Minimizing Loss

The expanding population of South Asia is facing the threat of water scarcity in the near future. The countries continue to struggle with providing safe drinking water to the population. One of the major challenges in the urban areas is the loss of water in distribution networks. Non-Revenue Water (NRW) is a reliable indicator to measure water loss. NRW is difference in the amount of water put into the distribution network and the amount of water billed to the consumers. The estimated volume of NRW in South Asia is 36,360,000 m^3/day. Assuming the value of water to be O.30$ per m^3, the water utilities of South Asia are losing 1.4 billion $ per year (Frauendorfer and Liemberger 2010). High levels of NRW indicate a poorly managed water utility. The losses can be curtailed reducing physical losses, ensuring the accuracy of meter and keeping the number of illegal connections within limits.

On the other hand, minimizing water losses during irrigation is also essential. The traditional irrigation practices, especially in South Asia (where agriculture is still the major occupation), should be shifted to more water efficient techniques as the water supplied is not in tandem with the requirement. Practices such as drip and furrow irrigation should be adopted. Also, misuse of freshwater rivers for waste disposal should be checked as this increases the reliability on groundwater and causes its depletion, accompanied by problems such as falling water tables, salinization, naturally occurring arsenic or fluoride contamination.

Rationalizing Water Pricing

With the burgeoning population and changing trends in water usage, there is a need to carry out demand-side management. Policies to regulate water pricing should be made, but the major constraint is the current subsidized system that does not meet the increasing operational costs. The charge levied for residential use in India is not even one-tenth of the entire economic cost; hence, a balanced approach is needed, especially in the urban sector where operational costs of water treatment and sewage treatment plants are ever on the increase but the tariffs are highly subsidized. It is difficult and challenging to design tariff structures which are consistent with the many conflicting objectives of the water sector (such as economic sustainability, efficiency, equity and affordability); and, in many cases, existing practices introduce distortions and produce undesirable effects, particularly for the poor. Reforms should be introduced such that the poor have access and affordability to the resource, and the service providers also get adequate funds to manage, augment and improve the supply. With no proper tariff system, there is little or no interest of the consumer towards water conservation and its economical utilization. Also, subsidies targeting the poor also need better implementation. There is a genuine need for a better pricing system as well as awareness among users towards water conservation and water-efficient appliances at all levels (residential, industrial, and institutional).

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4.3 Urban Environment

In South Asia, urbanization is increasing rapidly due to the uncontrolled population growth of the region. The process of urbanization in South Asia commenced in the late twentieth century. According to the UN, Department of Economics & Social Affairs, Population Division, the urban population of South Asia during 2011 was 32.6 percent. It has been estimated that by the middle of the 21st century, at least 50 percent South Asians will be residing in urban areas, which means that the urban population of this region will be over 1.2 billion. This will be larger than the urban population of numerous countries in the world. Though large city growth is an important feature of South Asian urbanization, it is not limited to large cities only. It is also taking place in small and medium cities. The extent of urbanization is not uniform in the countries of South Asia. Hence, it is misleading to focus on national figures alone in large cities.

Apart from the population growth, another factor contributing to urbanization in the region is the rural to urban migration. In the next two decades, the net rural to urban migration is expected to contribute to about 25-40 percent urban growth in this region, except in Bangladesh and Nepal. Some cities such as Bangalore, Delhi, Dhaka, Lahore and Karachi may receive more migrants in comparison to other cities. However, there is little evidence to support the frequently heard complaint that migrants swamp most South Asian countries.

Factors Leading to Urbanization

4.3.1 Definition of Urbanization

Urbanization is a form of social transformation from traditional rural societies to modern urban communities. It is a long term continuous process. There is no universal definition of urban areas. Different countries define urban localities in terms of different factors such as size and density of population, amenities considered to be commonly available in urban areas, major economic activities of population, etc. Also, not all those countries that define urban areas in terms of the same factors use the same threshold values for distinguishing urban localities from rural ones. For example, among those countries that define urban areas in terms of the minimum size of population, some countries define an area with a minimum population of 5,000 as urban while many countries define smaller places also as urban areas (say areas with a population of 2,000). This makes the comparison between the varying levels of urbanization among different countries as somewhat problematic. Despite a wide range of regional variation, the trend of urbanization is apparent in every major world region.

Box 22: Urbanization: Global Facts and Figures

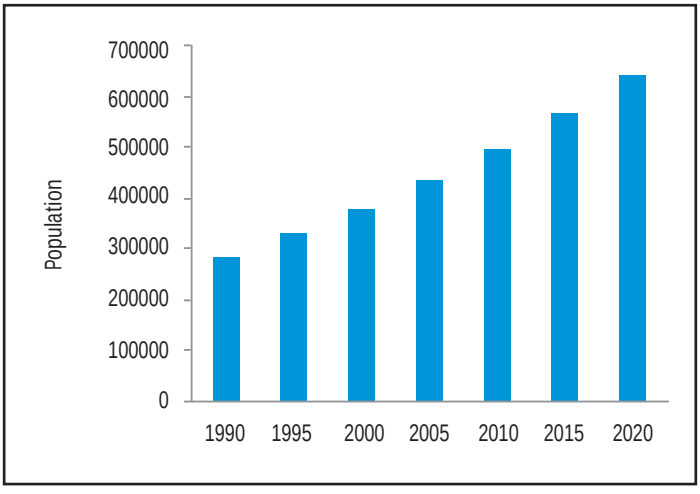
- In 1800, only two percent of the world's population was urbanized.
- In 1950, only 30 percent of the world population was urban.
- In 2000, 47 percent of the world population was urban.
- By 2030, it is expected that 60 percent of the world population will live in urban areas.
- Almost 180,000 people are added to the urban population each day.
- It is estimated that there are almost a billion poor people in the world; of this, over 750 million live in urban areas without adequate shelter and basic services.

Source: Compiled from various sources

4.3.2 Urbanization Trends

The challenges associated with urbanization are particularly great in South Asia due to the pace at which the population is growing. In 1996, the urban population in Bangladesh was 23 million. By 2020, it is expected to increase to 58 million. The urban population in Nepal, during the same period, will grow from 2.6 million to 7.7 million (UNEP and DA 2009). The major urban population of Bhutan is concentrated in just two cities: Thimphu and Phuentsholing. Thimphu alone has more than 40 percent of the total urban population of Bhutan.

Figure 36: Increase in Urban Population of South Asia



Source: UNDESA (2011)

4.3.3 Adverse Effects of Urbanization

In most South Asian cities, the urban infrastructure emerging gradually over several decades is under severe strain. Sanitation and solid waste management are some of the grave problems in South Asia. In this region, the sewerage system (covering both conveyance and treatment) exists merely in a few cities. Disaggregated and community-based systems in the slum improvement schemes in India and Pakistan have been promising but have not been scaled up.

In all South Asian cities, the total number of vehicles has gone up. About two-thirds of the vehicles produced in South Asia are two-wheelers or scooters. Since the engines of two-wheelers are two stroke engines, they are highly polluting.

Due to the rapid growth of South Asian cities, basic amenities (such as food, shelter and health services) are becoming insufficient everywhere. Large cities are unable to cope with the demands for civic services. Growing urbanization has also led to unchecked construction of houses without integrating environmental aspects related to the choice of the construction site, construction materials, etc. The demand of the construction sector on natural resources leads to injudicious extraction from rivers, quarries and clay pits. Poverty, insecure tenure, physical crowding, poor waste disposal, unsafe working conditions, overuse of harmful substances, and environmental pollution are other side-effects of urbanization. Unsustainable use of natural resources and environmental destruction also pose grave threats to urban productivity and restrict future development options.

Less than half the urban population in India has proper access to adequate toilet facilities. In the same vein, sewage treatment is virtually non-existent, culminating into 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 who have hardly any access to potable water and appropriate sanitation services. Due to their unhygienic living conditions, children residing in slums are more vulnerable to diseases and deficiencies than their rural and other urban counterparts.

Photo 31: Rapid Urbanization is Putting Strain on the Urban Infrastructure

Photo Credit: Jitendra Raj Bajracharya

4.3.4 Urban Waste

Urban waste broadly encompasses hazardous or chemical waste, solid waste and electronic waste (commonly known as e-waste). Larger the user base of electronic products, larger the waste generation. This category of waste includes old, end-of-life electronic appliances such as computers, laptops, TVs, DVD players, mobile phones, mp3 players, etc., which have been disposed by their original users. Apart from e-waste, large quantities of solid waste including unused and rejected chemicals (like fly ash, sludge, press mud, saw dust etc.) and unwanted industrial wastes are dumped on the soil surface by the industries. They are rarely put to recycling or safe conversion. Dumping of such wastes effect the physical and chemical nature of soil, pollute the groundwater, causes foul smell and disturbs the air composition.

In Bhutan, the issue of waste revolves around municipal solid waste, health care and industrial waste. Data on

industrial solid waste is currently not available. As for health care waste, the Health Care Waste Management Plan introduced by the Ministry of Health in 2004, provides an estimated figure of 73.2 tonnes of infectious waste generation per year. E-waste (such as TV, cell phones, computers) is emerging as one of the major environmental concerns stemming from the rapid socio-economic development and fast changing lifestyle of its people.

As per the current information obtained from SPCBs, Pollution Control Committees of Union Territories in, it is estimated that there are about 41,523 number of hazardous waste generating industries in India and their hazardous waste generation is about 7.90 million tonnes per annum. These wastes can be categorized into three components such as recyclable (3.98 million tonnes per annum), land fillable (3.32 million tonnes per annum) and incinerable (0.60 million tonnes per annum). Maharashtra (22.84 percent), Gujarat (22.68 percent) and Andhra Pradesh (13.75 percent) are the top three hazardous waste-generating states in India. Along with these three states, Rajasthan, Tamil Nadu, Madhya Pradesh and Chhattisgarh account for 82 percent of the country's hazardous waste. About 416 tonnes per day of Bio-Medical Waste (BMW) is generated in India.

Based on a survey carried out by the Central Pollution Control Board, it was estimated that 1.47 lakh metric tonnes of e-waste was generated in the India in the year 2005. Maharashtra, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab generate about 70 percent of total e-waste. Top ten e-waste generating cities are Mumbai, Delhi, Bengaleru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat, and Nagpur.

In case of Maldives, the main sources of hazardous waste on the islands are power stations, oil/fuel supply storage areas, fertilizer and pesticide storage areas, farming activities and hospital waste. Hazardous waste is handled and disposed no differently than the other forms of solid waste, except some healthcare waste. The resort islands transport hazardous components to the landfill site at Thilafushi, which stores oil, batteries, accumulators and other hazardous waste as well.

Pakistan is facing a grave threat from basic sources of hazardous waste-industrial, chemical, hospitals and a stock of obsolete pesticides. Amongst the industrial chemical generating units, the petroleum and petro-chemical industries as well as pharmaceuticals, tanneries, textiles, pesticides and fertilizers, paint, dye and inorganic chemicals contribute significantly to enhance the hazardous waste levels. In addition, the post-consumer electronic equipment has also been recognized as yet another source of waste generation that contributes to hazardous waste materials. Burning of plastics and chemicals (which again releases toxic substances and results in air pollution) has been a common practice amongst general public. These practices largely go unchecked by local authorities due to lack of awareness and inadequate monitoring mechanisms.

Photo 32: Increasing Solid Waste Generation has Emerged as a Major Environmental Problem

Photo Credit: NEPA, Afghanistan

Impacts

Solid waste generation and disposal has emerged as a major environmental problem, particularly in the urban areas in recent times. Rapid urbanization, growing affluence, changing consumption patterns, low level of awareness and poor civic sense are the key factors causing increased waste generation. In the urban environment, human health is threatened by poor waste management, lack of sanitation and safe drinking water, as well as air pollution. After a long period of more than 30 years, urban environmental problems such as air quality or waste management are receiving the required attention by the South Asian Governments.

The dumpsites of several large urban centres of Afghanistan - such as Kandahar and Herat-are located in areas prone to natural disasters, places where rainfall or flash floods could easily wash out the contents of urban waste into the open environment and pollute rivers. Kabul's dumpsite is poorly isolated from groundwater, posing significant risks in terms of contamination of vital aquifers.

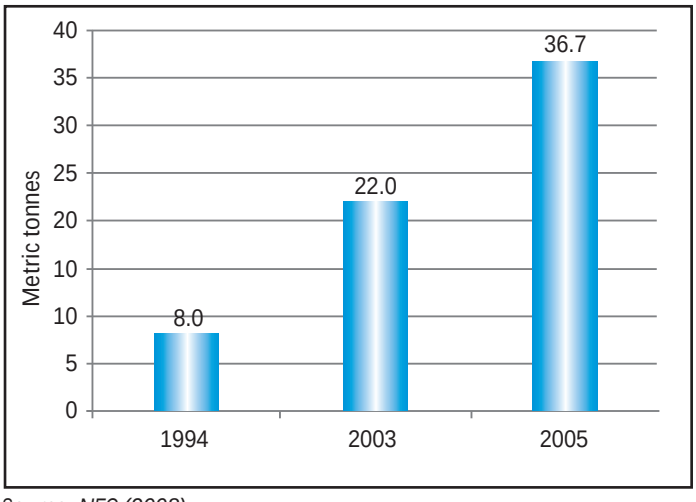
Solid waste generation is growing exponentially in Thimphu and Phuentsholing in Bhutan. In Thimphu, solid waste generation has witnessed an upward trend of nearly 67 percent from 2003-2005, when daily solid waste generation in the city was estimated to be 22 tonnes; and, an increase of an astonishing 360 percent since 1994, when daily solid waste generation in the city was estimated to be eight tonnes (NEC 2008). The daily waste generation at household level in 2008 was estimated at 50 tonnes and per capita solid waste generation at 0.54 kg.

Apart from the municipal solid waste, the generation of industrial solid waste, e-waste and health care waste has also increased in the city. In 2004, 73.2 tonnes of infectious waste per year was estimated to be released (NEC 2008).

About 130,822.31 tonnes per day of Municipal Solid Waste is generated in India. The average plastic waste generation amounts to approximately 7 percent of total municipal solid waste.

The amount of waste generated in Maldives has been continually increasing over the past few years due to the population increase and developmental activities. It was estimated that 297 kilo tonnes of waste was generated in Maldives in 2009 (Ministry of Environment and Energy, 2011). Solid waste in the country comprises domestic waste, industrial waste, construction debris, plastic, glass, scrap iron, saw dust and wood. Waste disposal (irrespective of solid waste or otherwise) poses various problems for the Male region and the rest of the inhabitant islands in the country. Waste generated from Male and other inhabitant areas is transported into Thilafushi dumpsite. Other inhabitant islands either dump or burn their waste somewhere in their own islands. Some inhabitant islands continue to have problems of littering and dumping in non-demarcated areas. Although this practice is less now since many islands have waste management centres (established additionally) after the decentralized process. In fact, each island or city council is mandated to manage solid waste in its individual jurisdiction.

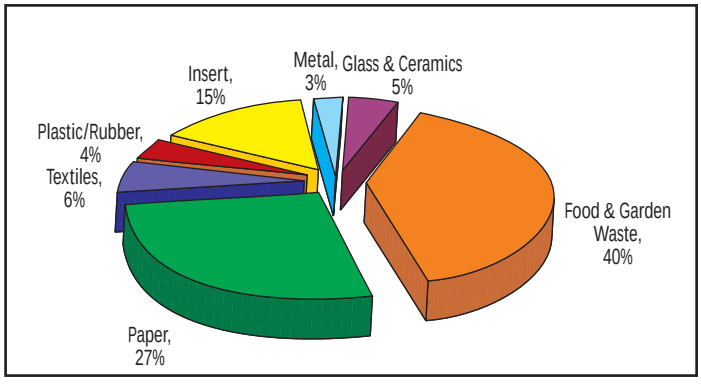
Figure 37: Daily Municipal Solid Waste Generation in Thimpu



Source: NEC (2008)

Nepal is one of the least developed countries in South Asia and the problem of waste management here is an urban phenomenon. In Nepal, waste management pertains to the domestic and commercial solid waste management, along with the domestic and industrial wastewater handling and treatment capabilities. Solid waste management primarily relates to disposing of wastes, whereas the waste combustion is hardly practiced in Nepal.

Figure 38: Composition of MSW in a Typical Indian City



Source: MoEF&CC(2009)

A situation similar to the rest of the region does exist in Pakistan as well. The table on the next page depicts a picture of the waste generated in selected cities in the year 2009. A waste disposal system is also functional in the cities of Pakistan, wherein the garbage is collected from homes in the provinces of Punjab, Sindh, Khyber Pakhtunkwa and Balochistan. In Sri Lanka, waste disposal was cited as the most critical issue in the entire solid waste management process. This problem has arisen due to a number of difficulties in finding suitable sites for disposal that would

conform to all the required environmental, economic and social needs. The industrial waste generated by the country was estimated to be 106.88 million tonnes. Apart from this industrial waste, 621.6 million tonnes of hazardous waste was also generated in the country in 2012.

Table 26: Waste Generation in Pakistan

City	Generation Rate (Kg/Capita/day)	Wast Generation (Tons/ day)
Gujranwala	0.469	824.0
Faisalabad	0.48	1170
Lahore	0.700	6720
Bahawalpur	0.50	253
Hyderabad	-	200

Source: FBS (2010)

Responses

The Bhutan Beverages Company Limited and Bhutan Agro Industries, in collaboration with the Thimphu City Corporation and NEC, have started a PET (Polyethylene Terephthalate) bottle recycling unit at Thimphu. Greenways is a private initiative of waste collection in Thimphu. In 2012, 516 tonnes of pet bottle, 540 tonnes of cardboard, 516 tonnes of plastic bottles, 72 tonnes of e-waste, 60 tonnes of aluminum and 336 tonnes of High Density polythene have been collected and similar initiatives are is place in other districts as well. At the policy level, the Ministry of Works and Human Settlements has drafted a national waste management strategy and action plan to combat waste management on a nationwide basis. The government has put in place a regulatory framework by enacting Waste Prevention and Management Act 2009 and Waste Prevention and Management Regulation 2012.The National Environment Commission Secretariat (NECS) is the overall regulatory authority responsible for overseeing and implementing the provisions in the Act and Regulation. As per the Regulation, all the implementing agencies have to report annually on the status of implementation to NECS. NEC is in the process of developing Integrated Solid Waste Management Strategy for Bhutan.

The Central Government of India, under the Environment Protection Act, 1986, has notified rules for management of hazardous wastes, municipal solid wastes, bio-medical waste, e-waste and plastic waste. The prescribed authorities for implementation of provisions of these rules are State Pollution Control Boards, Pollution Control Committees of Union Territories and Municipal Authorities in the area of their municipalities, etc.

Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, ensures safe handling, generation, processing, treatment, package, storage, transportation, use, reprocessing, collection, conversion, and offering for sale, destruction and disposal of Hazardous Waste. Ministry of Environment & Forests has notified the Municipal Solid Waste (Management and Handling) Rules (2000), making it mandatory for Urban Local Bodies (ULBs) to improve the systems of waste management as envisaged in the rules. These rules lay out procedures for waste collection, segregation, storage, transportation, processing and disposal. Regulation of plastic waste, particularly manufacture and use of recycled plastic carry bags and containers, is also being regulated in the country as per the Recycled Plastics Manufacture and Usage Rules (1999) and as amended in 2003.

In India, common Treatment, Storage and Disposal Facilities (TSDFs) are being used by various units/ industries for treatment, storage and disposal of their hazardous wastes on charge basis. These are particularly useful for small and medium scale hazardous waste generating industries that cannot set up their own TSDFs. The number of TSDFs in India has increased gradually from 4 facilities in 2003 to 38 presently. The existing TSDFs have a cumulative capacity of about 32 million metric tonnes for secure landfilling ,and about 0.18 million tonnes/ annum for incineration. There is adequate capacity for recycling/ reprocessing of the hazardous waste such as used oils, waste oils, Zinc dross/ Zinc residue, lead bearing waste, spent catalyst etc. listed in Schedule-IV of Hazardous Wastes Management Rules.

Bio-medical waste generated from health care facilities (HCFs) is required to be treated and disposed in accordance with the provision of the Bio-Medical Waste (Management & Handling) Rules, 1998. These Rules stipulates that bio-medical waste shall be treated and disposed of either by adopting requisite captive treatment facilities (like incinerator, autoclave, microwave system, chemical treatment/ disinfection or deep burial) or ensuring requisite treatment of waste at a Common Bio-medical Waste Treatment Facility (CBWTF) or any other waste treatment facility, in accordance with treatment and disposal options stipulated under the Rules. At present, there are 217 CBWTFs in operation in India. The concept of

Extended Producer Responsibility has been enshrined in the Rules on E-Waste and Plastic Waste Management to involve manufacturers of plastic carry bags, etc. and producers of electronic and electrical equipment in waste collection.

The Government of Maldives adopted the National Solid Waste Management Policy in 2008, which focussed on establishing and activating waste management governance, creating waste producers' duties, establishing waste management infrastructure, activating the waste management system, and influencing consumer choices and waste management practices. The Government also formed an enterprise called the Waste Management Corporation with the mandate of waste management operation throughout the country.

Nepal is one of the least developed countries where the problem of waste management is an urban phenomenon. In Nepal, waste management is basically related to the domestic and commercial solid waste management system as well as the domestic and industrial wastewater handling and treatment capabilities. Previously, organic wastes were traditionally reused for agricultural production by composting the household wastes. With the passage of time, segregation of municipal wastes and composting were integrated with the urban waste management process.

The Ministry of Environment of Sri Lanka has now taken positive steps to deal with this issue through the "Pilisaru" Waste Management Project. While waste generation has increased in every part of the country, its disposal has not kept pace with it, except in the Nuwara Eliya Municipal Council area, Balangoda PS, Weligama PS, Polonnaruwa PS and Bandaragama PS, to name a few. The Nuwara Eliya Municipal Council area has installed a sanitary landfill disposal system while the others have opted for composting and surface landfills.

Table 28: Municipal Solid Waste Disposal System (Sanitary Landfills/ Dumps) at Selected Cities of Pakistan in 2009

Name of City	Existing Dumps		Proposed land, fill/site
	Number	Size	
2002			
Bahawalpur	4	-	-
Peshawar	1	24 Kanals	-
Bannu	1	50 Kanals	Topi Ghulam Qadir
Quetta	1	65 Acres	Eastern By Pass
Sibi	Many sites	-	-
2009			
Gujranwala	-	-	Open dumping at Chauwali
Faisalabad	2	40 Acres	At Chak Muhammad Wala Jaranwala Road
Lahore	2	638 Kanal/Private Land	I) Kaachaa Village site ii) Sundar village site iii) Handoki landfill site iv) Tahayat pind landfill site
Karachi	2	500 Acres each -	Both the dump sites at Deh Jam Chakro, Surjani Town & Deh Gond Pass, Hub river Road are to be proposed as Engineered Landfill sites & at Deh Dhabeji, Bin Qasim town a piece of land measuring 3000 acres is proposed for establishment of Engineered landfill site.
Hyderabad	Many plots		-

Source: Federal Bureau of Statistics (2010)

Box 23: Solid Waste Management in Kanpur, India

Kanpur Nagar Nigam (KNN) had the responsibility of collecting, transporting and disposing the solid waste generated in the city, estimated at about 1500 tonnes per day. In June 2008, KNN gave a BOOT (build, own, operate, transfer) contract for processing, disposing, collecting and transporting solid waste to A2Z Infrastructure, a private company, which was selected through a process of competitive bidding. Land (46 acres) was given free for the project on a long lease of 30 years. A plant with the capacity to process 1500 tonnes per day of solid waste was set up with a tipping platform, a pre-segregation unit, a composting unit, an RDF (Refuse Derived Fuel) unit, a plastic segregating unit, a briquette manufacturing unit, and a secured landfill in place. Of the total project cost of `110 crores, `56.6 crores came from JNNURM and the rest from the private partner.

Door-to-door collection of garbage is being done in bins attached to rickshaws by *safai-mitras*, using hand gloves and protective masks. The garbage is compressed while being transported. Garbage transport vehicle is equipped with Global Positioning System (GPS) and every incidence of the compactor halt to collect garbage is monitored and recorded. Rag-pickers have been given a new lease of life. Some of the former rag-pickers (130, to be precise) now earn a regular salary as *safai-mitras*, sport a bank ATM card, enjoy social security and health benefits, and their young kids have also started going to school.

The garbage is taken to a central site where it is sorted, segregated, transformed into a number of products of value like premium quality compost, RDF, interlocking tiles from construction debris for use in footpath paving, and so on. Kanpur Waste Management Plant is the largest producer of compost from organic waste. However, the plant is not able to meet the growing demand for an organic fertilizer.

In 2010, A2Z Infrastructure, the private company, set up a waste-to-energy plant, creating the largest integrated project in solid waste management in Asia, which produces 15 MW of electricity, using RDF produced in house. The plant has been registered with UNFCCC for carbon credits, claiming certified carbon reductions achieved by CDM projects under the Kyoto Protocol. The KNN received the best city award (JNNURM) for improvement in solid waste management from the Prime Minister in 2011.

Source: Twelfth Five Year Plan, India (2012-2017). Faster, More Inclusive and Sustainable Growth

4.3.5 Urban Air Pollution

Recently, air pollution has received the top priority among environmental issues in Asia, as well as in other parts of the world. Exposure to air pollution is the main environmental threat to human health in many towns and cities. As a matter of fact, particulate emission is mainly responsible for the increased death rate and respiratory problems among the urban populace.

Impacts

In India, air pollution is proving to be an issue of major concern. India's ongoing population explosion, combined with rapid urbanization and industrialization, has placed significant pressure on its infrastructure and natural resources. The industrial development, at a considerable cost to the environment, has contributed significantly to the economic growthof India. Air pollution and its resultant impacts can be attributed to emissions from vehicular, industrial and domestic activities. Air quality has, therefore, been an issue of social concern in the backdrop of various developmental activities. There has been an unbalanced industrial growth, unplanned urbanization and devastating deforestation. Some cities in India have witnessed a decline in air pollution levels due to various measures taken by the Government. In fact, according to a World Bank study, Delhi, Mumbai, Kolkata, Ahmedabad and Hyderabad have seen about 13,000 lesser premature deaths from air-pollution related diseases. (MoEF&CC 2009)

In both urban and rural areas of Nepal, the change in the quality of outdoor and indoor air is an emerging concern. Air pollution, which occurs from natural as well as anthropogenic activities, is an outcome of dispersion from various pollutants like SO_x, NO_x, O_3, CO_2 etc, emitting from natural processes like the seasonal dust storm. Anthropogenic activities like vehicular and industrial emissions and combustion of biomass and fossil fuels have been largely responsible for changes in the air quality in both urban and rural areas. In the rural areas, heavy indoor air pollution is caused by the combustion of biomass in the poorly ventilated kitchen rooms. The emission of pollutants from the combustion of traditional biomass in open cooking-stoves, particularly in poorly ventilated kitchens, has its own implications on human health. Bronchitis,

pneumonia and other respiratory problems are very common among rural women and children. Furthermore, a statistically strong association of chronic bronchitis and decline in lung function has been reported due to burning of biomass fuel (Pandey *et al.* 1985). People residing in higher altitudes suffer from the aforesaid health problems frequently.

In Sri Lanka, increased vehicular traffic, high polluting industries and harmful gases emitted due to combustion have been the main contributors to air pollution.

Photo 33: Pollution from Road Surfacing in Bhutan

Photo Credit: Tshering Tashi

Responses

In Sri Lanka, the new regulation pertaining to the requirement for gas emission tests and clearance for all motor vehicles before the issue of revenue licenses (effective from November 2008) has been a positive step to curtail noxious gas emissions. In addition to monitoring and introducing the prerequisites pertaining to the clearance for vehicular gas emissions, the Ministry of Environment has ratified conventions and taken action on several other important issues.

Major activities initiated by the Ministry of Environment to bring down the air pollution levels are:

- Banning the use of leaded petrol in 2002
- Reduction of the sulphur content of Auto Diesel from 1.0g/Litre to 0.5/ Litre in 2005
- Drafting interim emission standards for specific industries
- Ratification of Vienna Convention for the protection of the ozone layer and Montreal Protocol in 1989
- Ratification of the UNFCCC in March 1999
- Ratification of the Stockholm Convention in 2005
- Kyoto Protocol

Urban air quality monitoring in Afghanistan is in its nascent stage. It is only recently that urban environmental issues, including ambient air pollution, have attracted the attention of both the government and the public. An inventory of air emissions in Kabul and a report on Afghanistan's greenhouse gas inventory were produced in 2007. These reports comprise a description of preventive methods, a comprehensive dataset and initial recommendations to address the problem.

4.3.6 Countering Urban Issues

South Asian cities are drowning in their own waste. Due to continued high population growth and economic development in urban areas, many public, private and 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 forms the very basis for settlement hygiene and prevention of diseases and hence, it is the foundation for any development activity aimed at poverty alleviation.

To address our collective infrastructure, mobility, energy, housing, water, and waste management needs, a new paradigm must be evolved to work across artificial institutional silos and sectoral concerns.

Cities need to be planned, designed, and developed to lessen their impact on the environment; be resilient to the effects of climate change; and, contribute to the economic growth. Compact cities, with well-designed services and infrastructure, reduce the cost of energy provision, transport, and other services that businesses need. This, in turn, increases the productivity as well as efficiency, and encourages private investment for economic growth.

The green economy presents new opportunities for shared prosperity. It will not only contribute in terms of achieving the MDGs such as poverty eradication, food security, sound water management and sustainable cities, but will also provide stimulus for employment and development.

Communities, businesses, and local authorities must be recognized as essential players in developing and implementing national and city-level climate change strategies and socio-economic development. From playing

South Asia Environment Outlook 2014

a marginal role within climate change frameworks and funding mechanisms, we must today seize the opportunity to harness the potential of cities to realize a sustainable future for all.

Decentralization is an effective instrument for inclusive and sustainable urbanization. Contained in India's amendment to its Constitution in 1992 (Constitution 74th Amendment on Municipalities), Local Self-Governance Act (1999) in Nepal, and the Local Governance Ordinance (2001) in Pakistan, decentralization provides the Constitutional and statutory framework for municipalities to formulate urban development strategies to meet local priorities and address local problems. The Nepal Local Self Governance Act (1999), for instance, aims at constituting local bodies for the development of a local self-governance system to take decisions on matters affecting the day-to-day needs and lives of the people. The 2001 Local Governance Ordinance in Pakistan focuses on developing political power and decentralizing administrative and financial authority to form accountable local governments for good governance, effective service delivery and transparent decision-making through institutional participation of the people. The 74th Constitutional amendment of India, inter-alia aims at expanding the functional space for municipalities as they represent de-facto recognition of the increasing role of cities in the national and global economy.

Urban poverty reduction strategies (including slum improvement) should be integrated into the City Development Plans. Designing discrete programmes for the urban poor and slums is sub-optimal; and, urban regulations in respect of land, housing, and infrastructure and services are far too constraining.

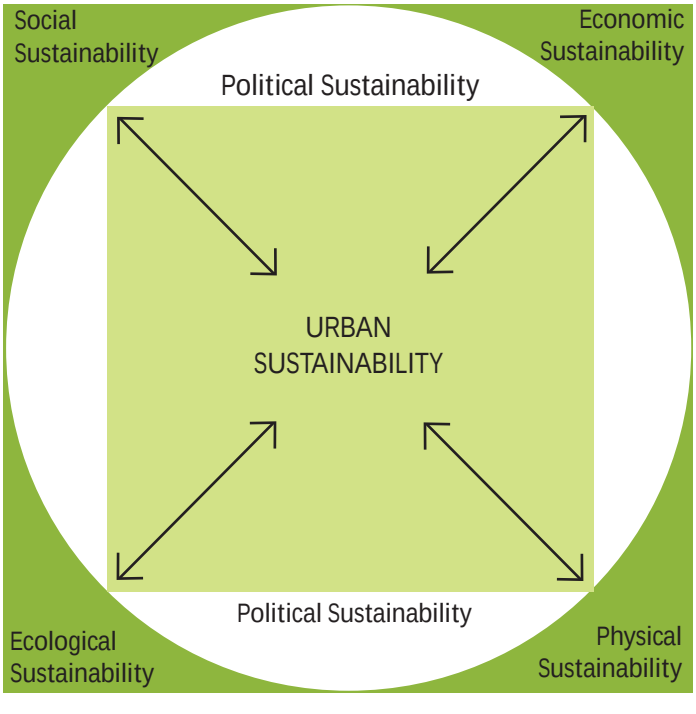
Without appropriate planning, design, and investment in the development of sustainable cities, a growing number of people will continue to face unprecedented negative impacts, not only of climate change but also of reduced economic growth, quality of life, and increased social instability.

Sustainable Urbanization

Over the last two decades, demographic and economic changes have catapaulted cities and urban centres to the status of the principal habitat of humankind. Cities are not only where rapid improvements in socio-economic and environmental conditions are possible, but, indeed, where such changes are most needed. The cities of the world's emerging economies are increasingly becoming drivers of global prosperity while the planet's resources are fast depleting. It is, therefore, more critical than ever that Member States and UN agencies commit themselves to realize the goal of sustainable urbanization as a key lever for development.

There is an urgent need to find various ways of achieving economic and socially equitable growth without any further cost to the environment. Part of the solution lies in how cities are planned, governed, and provide services to their citizens. When poorly managed, urbanization can be detrimental to sustainable development. However, with appropriate vision and commitment, sustainable urbanization is one of the optimum solutions to our ever growing global population. Efforts to create jobs, reduce our ecological footprint, and improve the quality of life are most effective when pursued holistically. By prioritizing sustainable urbanization within a broader development framework, many critical development challenges can be addressed in tandem such as energy, water consumption and production, biodiversity, disaster preparedness and climate change adaptation. It is vitally important that this emerging opportunity be recognized and endorsed at Rio+20.

Figure 39: The Five Dimensions of Urban Sustainability



To assess whether any given practice, policy or trend is moving towards or against urban sustainability, it is necessary to consider the relationships among the five dimensions outlined below. Economic sustainability is understood as the capacity and ability of a practice to be able to put local/regional resources to productive use for the long-term benefit of the community, without damaging the natural resource base or increasing the city's ecological footprint. This implies taking into consideration the full impact of the production cycle.

Social sustainability refers to the fairness, inclusiveness and cultural adequacy of an intervention to promote equal rights over the natural, physical and economic capital that supports the livelihoods and lives of local communities, with particular emphasis on the poor and traditionally marginalized groups. Cultural adequacy in this context means the extent to which a practice respects cultural heritage and diversity.

Ecological sustainability pertains to the impact of urban production and consumption on the integrity and health of the city region and the global carrying capacity. This demands the long term consideration of the relationship between the state and the dynamics of environmental resources and services as well as the demands exerted over them.

The sustainability of the built environment concerns the capacity of an intervention to enhance the livability of buildings and urban infrastructures for 'all' city dwellers, without damaging or disrupting the environment of the urban region. It also includes a concern for the efficiency of the built environment to support the local economy.

Last, but not the least, political sustainability is concerned with the quality of governance systems guiding the relationship and actions of different actors among the previous four dimensions. Thereby, it implies the democratization and participation of local civil society in all the areas of decision-making.

The diagram (Figure 39) depicts the relationship between the five dimensions outlined above in a simplified manner. The outer circle represents the ecological capacity of any given urban region and acts as a relative measure to assess whether changes or interventions in each of the five dimensions are moving towards or against sustainability. The corners of the square base or pyramid within the circle represent the economic, social, ecological and built environment dimensions, while the political dimension articulates them. If the four dimensions of the pyramid are seen as pulling against each other, attempting individually to break out of the circle itself, the political dimension can then be witnessed as the regulating mechanism ensuring that they remain within the periphery of sustainability.

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4.4 Energy Security

In simple terms, energy security is the ability of a nation to meet the energy demands of the population in a sustainable way. Maintaining sufficient energy supply, ensuring energy access to all sections of society and determining prices in such a way that it is affordable to all are vital to all the countries. With the energy demand growing exponentially in South Asia, energy security is of paramount concern for all the countries.

4.4.1 Energy Mix

The energy mix of the countries in South Asia is heavily dominated by fossil fuels. However, the main source of energy varies across the region. Bhutan is heavily dependent on hydropower while natural gas is the major source of energy for Bangladesh.

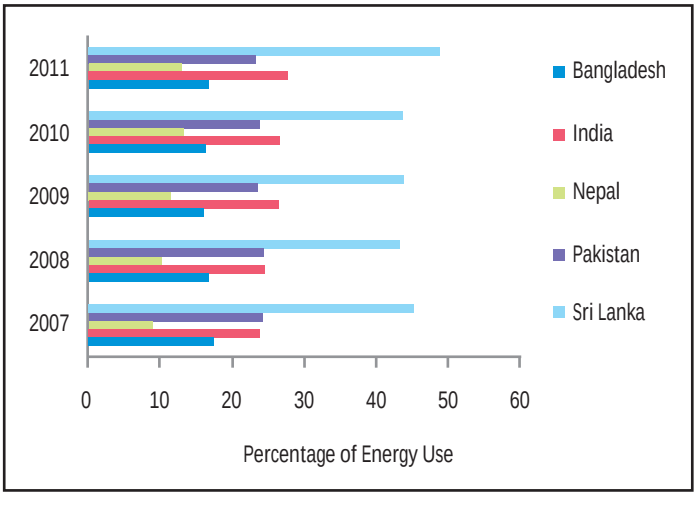
Table 29: Energy Production and Consumption in South Asia (2009)

Country	Coal (Thousand Metric Tons of Coal Equivalent)		Crude Oil (Thousand Metric Tons)		Natural Gas (Billion cubic metres)	
	Production	Consumption	Production	Consumption	Production	Consumption
Afghanistn	500	500	---	---	0.004	0.004
Bangladesh	612	612	---	1000	18.27	18.27
Bhutan	49	21	---	---	---	---
India	452,095	499,006	33,690	192,950	41.16	41.16
Nepal	16	324	---	---	---	---
Pakistan	2,352	6,997	3,180	10,206	34.90	34.90
Sri Lanka	---	76	---	2,009	---	---

Source: UNSD (2012)

With the advancement in technology, the production of primary energy like crude oil, natural gas liquids and oil from non-conventional sources; natural gas, solid fuels like coal, lignite and other derived fuels; combustible renewable and primary electricity has increased in recent times. Despite the increase in production, it is far below the consumption of energy by the countries as depicted below. Bhutan, Maldives, Nepal and Sri Lanka are completely dependent on import of fossil fuels to meet their requirements.

Figure 40: Net Energy Imports



Source: World Bank (2011)

Existing demands for energy are putting immense pressure on the fossil fuels (i.e. coal, petroleum and natural gas). It is essential to diversify the energy mix and increase the share of renewable energy to enhance the energy security of the region. Use of alternatives sources such as nuclear, geo-thermal, solar etc. will also reduce GHG emissions in the region. Nepal and Bhutan utilize hydro-resources to meet their energy requirements. Bhutan is developing its hydropower potential to reduce its dependence on fossil fuels. The government plans to increase its installed capacity from 1,488 MW to 10,000 MW in the next 20 years. Several projects are expected to be implemented during the Tenth Five Year Plan (July 2008-June 2013). Construction of Punatsangchhu-I and Mangdechhu has already started.

Table 30: Hydropower Potential and Installed Capacity in South Asia

Country	Theoretical Potential (Gigawatt hours per year)	Installed Capacity (Gigawatts)
Afghanistan	394,000	0.374
Bangladesh	4,000	0.23
Bhutan	263,000	1.505
India	2,638,000	36.924
Nepal	733,000	0.573
Pakistan	475,000	6.481
Sri Lanka	21,000	1.391

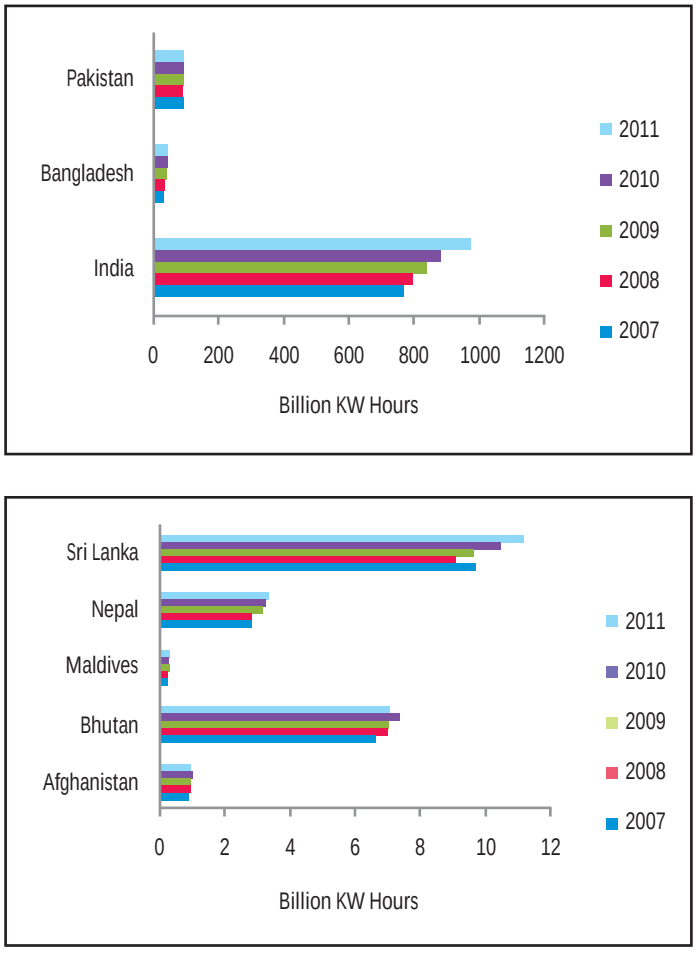
Source: UNSD (2012)

Solar energy and biogas are also being promoted to provide decentralized solutions in rural areas of countries like Bangladesh, Bhutan, India, Sri Lanka and Nepal.

Electricity Generation in South Asia

South Asia generated approximately 1030 billion kw hours of electricity in 2011. Electricity generation has been constantly increasing in the region to fulfil the requirements of the population, industry and other sectors. It has increased by about 19 percent from 2007. Among the countries, India is the biggest producer of electricity in the region. It produced 975 billion kw hours in 2011. The installed capacity of power sector in India is 2, 28,721.73[20] MW. The proportion of electricity produced by Maldives is the smallest in the region.

Figure 41: Electricity Generation in South Asia



Source: www.eia.gov

4.4.2 Energy Access

Electricity is indispensable for human activities, starting from basic activities such as refrigeration and running of other household appliances to industrial activities. Therefore, access to electricity is crucial to human development in every country. Bhutan has the highest level of electrification, followed by Sri Lanka and Nepal. Afghanistan has the lowest level of electrification. Despite such high level of electrification in the country, India still has the highest number of people without access to electricity, owing to its large population.

20 www.powermin.nic.in

Table 31: Access to Electricity in South Asia

Country	Percentage of Population
Afghanistan	30
Bangladesh	59.6
Bhutan	92
India	75.3
Nepal	76.3
Pakistan	68.6
Sri Lanka	85.4

Source: World Bank (2010); Bhutan Living Standard Survey 2012

Access to energy can also be measured in terms of access to modern cooking fuels such as LPG, or more efficient appliances/cookstoves that rely on traditional sources and yet exhibit an advance in efficiency and convenience. Majority of population rely on traditional sources such as biomass for cooking. About 69 percent of population relied on traditional biomass for cooking in 2010 in the region. Out of this percentage, 87 percent of the rural population used biomass. High dependence on biomass leads to indoor air pollution. It is one of the major causes of respiratory ailments.

Table 32: Snapshot of People Relying on Traditional Biomass for Cooking Across the World in 2010

Country	Population Relying on Traditional Biomass (millions)	Percentage of Population Relying on Traditional Biomass	Installed Capacity (Gigawatts)	Percentage of Rural Population
Africa	698	68	44	83
Developing Asia	1,814	51	17	71
China and East Asia	716	36	12	56
South Asia	1,098	69	27	87
Latin America	65	14	5	50
Middle East	10	5	1	14

Source: UNSD (2012)

A number of initiatives have been launched to increase the use of modern forms of energy. Improved cookstoves are being disseminated in countries like Nepal and India. The Rajiv Gandhi Grameen Vidutikaran Yojana and the remote electrification programme in India aim to provide electricity access to rural areas. Similarly, Nepal has a community rural electrification programme. Biogas plants are also being established at a large scale with the support of Alternative Energy Promotion Council (AEPC).

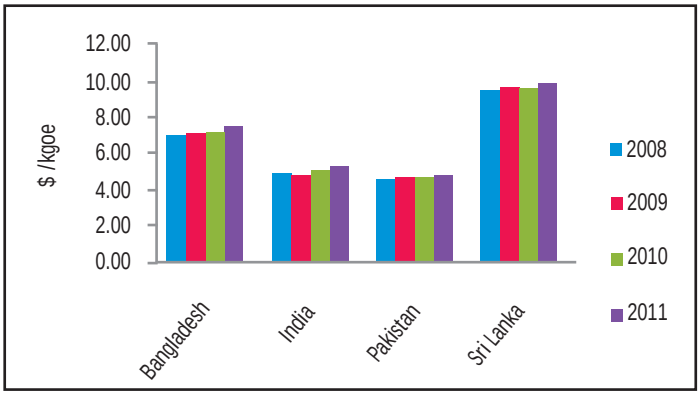
Photo 34: Majority of Rural Population Depends on Traditional Biomass for Cooking

Photo Credit: South Asia Environment Outlook 2009

4.4.3 Energy Efficiency

Efficiency of energy production and use, as a component of demand side management, is crucial to the energy security of the region (UNESCAP 2012). Energy efficiency of a country can be measured by calculating GDP per unit of energy use. The following figure presents the trend in energy intensity of GDP in countries of South Asia.

Figure 42: Energy Intensity of GDP (Constant 2005 PPP $ per kg of oil equivalent)



Source: World Bank (2011)

Introduction of energy-efficient practices is vital for countries that have high transmission and distribution losses. Such measures would not only lead to reduction in demand of electricity, it would also result in large monetary savings. Building energy codes, labelling schemes and standards, fuel efficiency norms are a few such measures. South Asian countries have already initiated many schemes to improve the energy efficiency. The Bureau for Energy Efficiency (BEE), India came up with the Energy Conservation Building Code (ECBC) to provide minimum requirements for energy-efficient design and construction of buildings. A Star Rating Programme for Appliances and Buildings was also developed to label energy efficient buildings and appliances. Sri Lanka has also introduced policies for labelling of appliances. Standards and labelling programmes at regional scale will provide an opportunity for creation of regional markets for energy efficiency.

Recognizing the need for industrial energy efficiency, India has introduced the Perform, Achieve and Trade (PAT) scheme that involves trading of energy saving certificates. The national energy policy of Maldives aims to achieve a 7.5 percent reduction in energy consumption by 2020 through efficiency improvements. It identifies public buildings and the tourism sector as priorities. It further points out a number of areas with potential for improvement: building design, air conditioning and ventilation, low energy lamps and solar lighting, and solar water heaters.

4.4.4 Measures to Enhance Energy Security in the Region

Bangladesh is trying to ensure energy security by increasing the generation capacity of electricity, increasing the efficiency of energy use as well as reducing this system loss, diversifying fuel use in power generation, increasing private sector participation to mobilize resources in electricity, gas and other energy supply, reducing the demand-supply gap in both the primary (fossil fuel) and secondary (electricity) sectors, and by conserving energy. Other initiatives include intensifying exploration activities both in onshore and offshore areas to find new oil and gas fields, introducing a labelling system with a view to ensuring the use of energy efficient equipment, developing coal fields for reducing dependency on natural gas and increasing the usage of renewable energy by five percent of electricity demand by the end of the Perspective Plan period (i.e. by 2021). The Integrated Energy Policy of 2009 aims to simplify the complex system of subsidies in India to promote energy efficiency and security. This policy aims to achieve a gradual harmonization of domestic energy prices and global prices, while still allowing for targeted subsidies to low-income segments of the population.

The national policies of Pakistan aim to stimulate an increased extraction of natural gas and coal, with a view to reduce the country's dependence on imported oil. The Ministry of Power and Energy, Sri Lanka has set a goal of achieving 10 percent of electricity supply from non-conventional renewable sources by 2016. As a part of regional cooperation, Bhutan is expected to export about 5000 MW of hydropower annually by 2020, mostly to India.

Promotion of Renewable Energy

The government of Maldives is also promoting the use of renewable energy through a number of initiatives like the waiver on import duties on renewable energy powered vehicles, solar batteries and solar panels used in marine vessels. Utility companies have planned to purchase renewable electricity at the rate of Rs 3.50 per unit of electricity (Ministry of Environment and Energy 2011). The Electricity Act (2003) of India provides for regulatory interventions for the promotion of renewable energy sources through determination of tariff, specifying renewable purchase obligation (RPO), facilitating grid connectivity and promotion of development of market. The National Tariff Policy (NTP) 2006 requires the State Electricity Regulatory Commissions (SERCs) to fix a minimum percentage of Renewable Purchase Obligation (RPO) from such sources, taking into account availability of such resources in the region and its impact on retail tariffs and procurement by distribution companies at preferential tariffs determined by the SERCs. The policy was amended in January 2011 to prescribe that solar-specific RPO be increased from a minimum of 0.25 percent in 2012 to three percent by 2022. Further, NAPCC suggests increasing the share of renewable energy in the total energy mix at least up to 15 percent by 2020. Several Memorandums of Understanding (MoU) have been signed between India and various countries like US, Denmark, South Africa, Brazil, Spain and Italy etc. as a part of international cooperation.

Box 24: Clean Energy for Ladakh

In collaboration with EU, BORDA (Bremen Overseas Research and Development Association), GERES (Group Energies Renouveable, Environment et Solidarites), and SD Tata Trusts, the Ladakh Ecological Development Group (LEDeG) has commissioned a micro-hydro power unit in the Udmaroo village of Nubra block to improve the living conditions of the inhabitants. The Village electricity committee is looking after the maintenance of the unit. The villagers have established carpentry and saw machine, a flour machine and an oil expeller machine, providing livelihoods to many families.

LEDeG has also commissioned four small solar photovoltaic plants in 2011 in four remote villages of Ladakh (Maan, Shayok, Juldo and Tashistongday).

Source: MNRE (2012)

The Policy for Development of Renewable Energy for Power Generation (2006) has several initiatives for the development of renewable energy in Pakistan. Some of the initiatives include private sector investments, de-licensing and deregulation of small scale power regulation, transparent rules for tariff determination. It facilitates projects to obtain carbon credits for avoided greenhouse gas emissions, helping improve financial returns and reducing per unit costs for the purchaser. Several fiscal incentives have been provided in the Renewable Energy Policy of Bangladesh like VAT exemption on renewable energy equipments and related raw materials, establishment of micro-credit support system in rural and remote areas, subsidies to utilities for installation of solar, wind, biomass or any other renewable/clean energy projects, private sector investment etc. Other initiatives include creation of the Sustainable Energy Development Authority, preparation of the Energy Conservation Act, expansion of development of renewable energy, implementation of cost effective energy procedure, standardization of energy saving electronic equipment, setting up 14 thousand solar home systems in rural areas, and running pilot projects to produce power from waste. The use of solar panels in all large public buildings is to be made mandatory within three years, and import of solar panels to be made duty-free.

Photo 35: Fast Flowing River a Source for Hydropower Generation

Photo Credit: Tshering Tashi

AEPC was established in 1996 in Nepal. It works with off-grid rural energy and focuses on micro-hydro (of less than 1MW capacity), biogas, and solar energy. AEPC is promoting the adoption of these technologies by providing subsidies, 85 percent of which are covered by donors and the remaining part by the government. So far, 300,000 solar home systems have been delivered and 15 MW capacity of hydro power has been installed. Sri Lanka has set a target of developing over 1700 mini/micro hydropower projects by 2016. It also aims to promote other renewable energy sources such as wind, waves, solar, ocean thermal electric conversion, and waste to energy, and biogas from sewage.

4.4.5 Regional Cooperation in South Asia

The process of regional cooperation in the energy sector began in January 2000 with the establishment of a Technical Committee on Energy. The Technical Committee on Energy met twice. Thereafter, recognizing that this vital area requires focused attention, the Council of Ministers approved the creation of a specialized Working Group on Energy in January 2004. The First Meeting of the SAARC Energy Ministers (Islamabad, 1 October 2005), decided on the formation of an Expert Group to deliberate on the options and potential of energy conservation and energy efficiency measures and to formulate a road map for implementation in the SAARC region. The Expert Group formulated a Road Map for implementation by the Member States.

The Thirteenth SAARC Summit, decided to establish the SAARC Energy Centre in Islamabad; to promote development of energy resources, including hydropower;

and energy trade in the region; to develop renewable and alternative energy resources; and promote energy efficiency and conservation in the region. The Centre which was established in 2006 has become fully operational. As directed by the Thirteenth SAARC Summit, the government of India organized South Asia Energy Dialogue on 5th March 2007, which was attended by experts, academic think tanks and other stakeholders in the region. The Dialogue made a number of recommendations to promote cooperation in this vital area. The concept of Energy Ring was developed by an Expert Group, which was approved by the Energy Ministers in their Third Meeting held in Colombo in January 2009. The Working Group, since its establishment in 2004, had held five Meetings so far, and made a number of important recommendations to promote cooperation in the field of Energy among the Member States. It prepared a Plan of Action in its First Meeting held in Islamabad in June 2004, which is under implementation. The Fifth Meeting held in Bhutan in April 2009, decided to establish Experts Groups on; a) Oil and Gas, b) Electricity, c) Renewable Energy and, d) Technology/knowledge sharing (including energy efficiency, coal etc.). These Experts Groups will prepare ground work for energy cooperation in the specific Energy commodity. A Task Force has finalized a common template on technical and commercial aspects of electricity grid inter-connection amongst the SAARC Member States.

The role of regional cooperation will be crucial for enhancing the energy security of South Asia. Geographically close countries can explore the potential of regional cooperation on hydropower. Hydroelectricity produced in one country can be exported to other countries. However, the development of hydropower potential should be in strict compliance with environmental, social and economic sustainability criteria.

Box 25: Bhutan-India Cooperation in Power Development and Trade

India has played a significant role in the hydropower sector of Bhutan, with the provision of technical and financial assistance, including project design and engineering services, construction supervision services for hydro projects and transmission lines, as well as easy finance. Bhutan-India energy cooperation started in 1967, when Bhutan started importing electricity through the Jaldhaka hydropower plant, located in West Bengal, India. The cooperation initiative got further strengthened with the development of the 336 MW Chukha Hydel project that was commissioned in 1989. Immediately, it became a source of revenue, export earnings and overall economic development for Bhutan as about 75 percent of the project's total generation capacity was exported to India. By 2007, two more hydel power projects came up in Bhutan with Indian assistance: the 60 MW Kurichhu and 1,020 MW Tala hydro power projects. Realizing the potential of such projects as a means to earn more revenues and further economic development, Bhutan signed a Framework Agreement with India in December 2009, whereby India committed to develop 10,000 MW of installed capacity in Bhutan by the year 2020 and to buy a minimum of half of it. The 1,200 MW Punatsangchhu-I Hydroelectric project is already under construction and planned to be commissioned by 2015, while other projects are under discussion. Detailed project reports for the same are being prepared.

Source: Bisht (2011)

Reference

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4.5 Food Security

At the World Food Summit in 1996, food security was defined as the scenario wherein all people at all times have access to sufficient, safe, and nutritious food to maintain a healthy and active life. Food insecurity can arise due to insufficient availability or access to food. It varies with income levels, food prices and even political instability. Despite the availability of sufficient and balanced diet, lack of hygiene and access to healthcare can also lead to food insecurity. As a matter of fact, food security is not simply linked to health but also to sustainable economic development, environment and trade.

4.5.1 Role of Agriculture in South Asia

South Asian countries are heavily dependent on agriculture, not only for their consumption but also for the livelihood of the poor. Agriculture contributed to approximately 19 percent of the GDP of the region in 2013 (World Bank 2013). Agriculture is a major employment sector in the region, engaging 56 percent of the labour force. However, the percentage of the labour force dependent on agriculture has decreased slightly in recent years. One of the major reasons for this decrease can be the rural-urban migration of workers. With the advent of economic development, the workers are also able to attain better jobs.

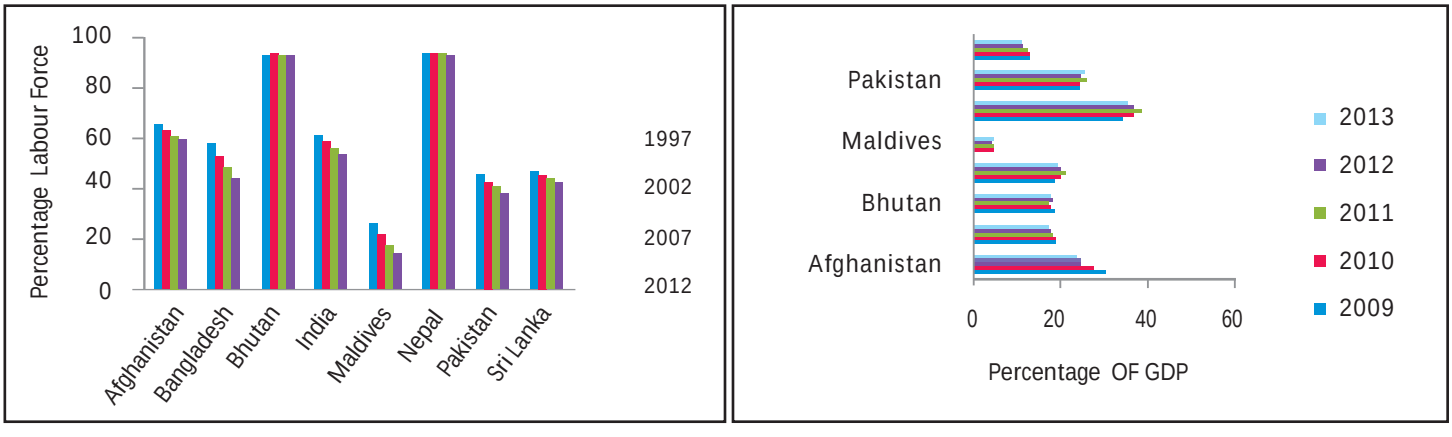
4.5.2 Economic Growth and Food Security

Economic growth contributes greatly in terms of improving the food security in the region. South Asia has been one of the fastest growing regions in recent years. The growth rate in the region was more rapid in the 2000s than the 1990s (FAO, WFAP and IFAD 2011).

Economic growth contributes significantly to reduction in food insecurity and hunger in the region. Economic growth (i.e. growth in GDP per capita) results in opportunities for the poor to diversify their diets and attain access to other fundamental amenities like improved sanitation and safe drinking water, access to health services, etc. It also helps in increasing their awareness about proper nutrition for children.

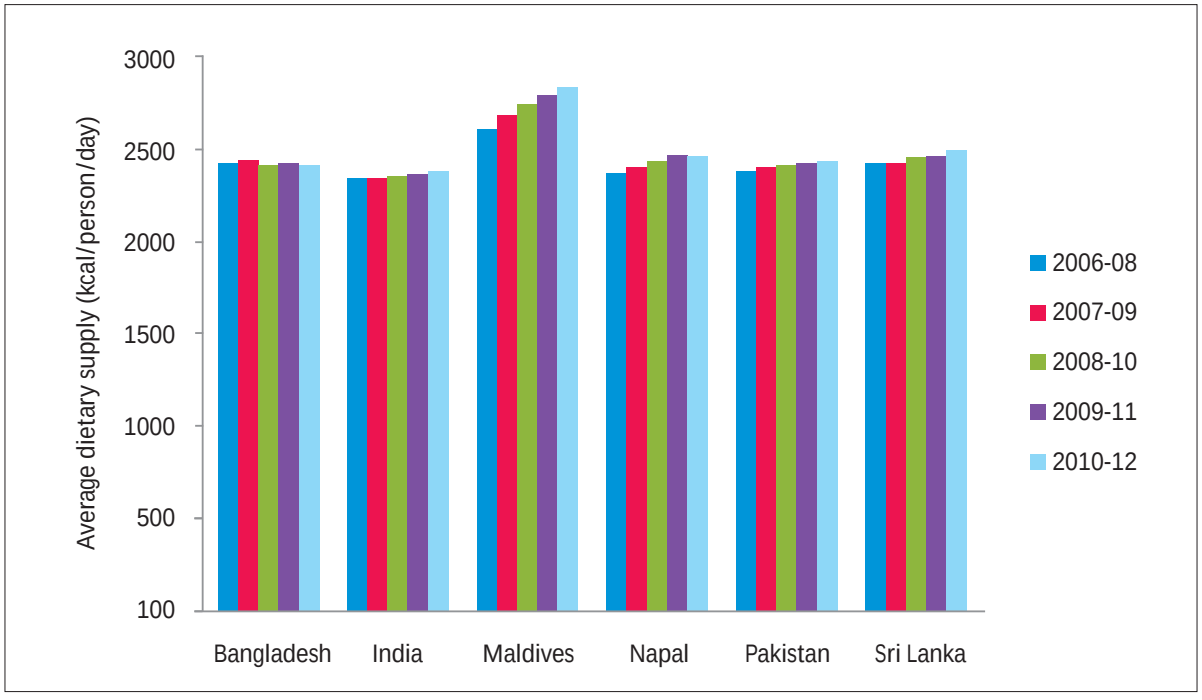
The economic growth in the region has translated into increased dietary energy demand and supply. The average dietary supply in South Asia (including Iran) has increased from 2300 kcal/person/day in the period of 2000-2002 to 2420 kcal/person/day in 2010-12. According to Bhutan RNR Statistics 2011, the yearly per capita food supply for Bhutan for 2008, 2009 and 2010 was 905,272, 908,147 and 898,616 calories respectively. The daily per capita calories supply calculates to 2515.

Figure 43: Agriculture, Value Added (Left) and Labour Force in Agriculture (Right)



Source: World Bank (2012); FAO, Statistics Division (FAOSTAT)

Figure 44: Countrywise Average Dietary Supply



Source: FAO, Statistics Division (FAOSTAT)

Similarly, poverty is one of the determinants of hunger and food security. Lower income households spend a major portion of their income on food items as compared to the middle and higher income families. Their inability to consume sufficient food would have adverse impacts on the labour productivity as well. Although there have been considerable progress in the reduction of poverty in the region on account of economic growth, the share of people living on less than 1.25 USD per day was still 506.77 million in 2010.

According to Engel's law, the expenditure on food may actually increase with the income. However, the proportion of expenditure on food as a proportion of income decreases. Due to lack of data on the share of food expenditure of the poor in South Asia, it is difficult to observe a conclusive trend on the effect of income growth on the food expenditure. However, in India, the share of food expenditure decreased from 74 percent in 1994 to 60 percent in 2003. A one percent decrease was observed in Bhutan from 66 percent in 2000 to 65 percent in 2005 (FAO, Statistics Division)

4.5.3 Climate Change and Food Security

Climate change and food security are inter-linked issues as agricultural productivity is affected by climate change. It affects food production through changes in land suitability and crop yields due to changes in temperature, precipitation and emission of greenhouse gases. The emission of greenhouse gases in the region has been increasing exponentially over the years. The increase in concentrations of carbon dioxide may have the potential to increase the productivity of agro-ecosystems, enhancing the biomass accumulation and thus, the crop yield. However, according to IPCC predictions, the crop yields in South Asia could decrease up to 30 percent in the future even if the positive effects of CO_2 are accounted. This can be attributed to the temperature increase in the region. IPCC has predicted the global warming to be stronger in South Asia. Significant reduction is crop yields due to global warming is predicted. This projected decrease in the crop yields in the future would put additional pressure on the countries to meet the demands of the population. The crop yield will also be affected by the frequency of extreme weather events like droughts, floods and erratic rainfall. Apart from affecting the crop yield, climate change will also impact the area of production, irrigation demands and the severity of erosion.

Access to food will depend on the price of the food products. Due to the decline in productivity owing to climate change, the global cereal prices are expected to increase by more than three-fold by 2080s (Parry *et al.* 2004). This volatility of the prices will affect the access to food for the poor which will ultimately be translated into

high risk of hunger in developing countries, with an additional 49 million, 132 million and 266 million people of Asia projected to be at risk by 2020, 2050 and 2080 respectively, as per the A2 scenario (without carbon fertilization).

Also, the changing pest and disease patterns will affect the productivity of food systems. This will heavily influence food security in regions like South Asia that are highly dependent on agriculture.

4.5.4 Global Food Price Hike

The food prices all over the world in 2007-08 had reached their peak in the last 30 years. According to the World Food Price Index of FAO, the international food prices in April 2008 were 60 percent higher than a year earlier. For the second time in four years, the prices soared in 2011. FAO predicted the prices to increase again in March 2013. The increase in food prices has slowed down the reduction of hunger around the world.

The increase in the prices of wheat and rice in South Asia was somewhat less as compared to the rest of the world. The price of wheat increased by only 33 percent from 2002-2008; and, by 12 percent during 2006-2008. On the other hand, Pakistan experienced a sharper price hike of 37 percent between 2006 to March 2008. However, such a trend was not visible in Afghanistan. Wheat prices showed an increase of 157-259 percent between May 2007 and 2008. In the case of rice, Pakistan witnessed the most rapid increase followed by Bangladesh, Sri Lanka, Nepal and India. According to the World Bank, deteriorating weather conditions might further affect the price trends in the region, especially in India.

The reason for the minimal price hike in the countries of South Asia, as compared to other countries, is the low dependence of countries on import of food materials. These countries rely on the domestic production of food grains, with the exception of Afghanistan. Afghanistan is not agriculturally self-sufficient and thus, must rely on food aid and imports (NEPA 2008). Very mild impact was seen in India owing to the timely interventions by the government and the public food distribution system. India also tightened the export restrictions to fulfil the demand of domestic customers.

Food price hike is a major cause for the rise in inflation in the region. This increase also contributes to the escalating poverty in the region. It has a detrimental effect on the poor, especially children, due to a switch in the consumption from nutrient-rich food to lower quality food. Consequences of food price hike are evident in the increasing risk of malnutrition. Currently, 1.5 to 1.8 million more children are facing the risk of malnourishment in India (World Bank 2008).

Photo: 36: Hike in Food Prices has a Consequence on the Food Security of the Region

Photo Credit: ICIMOD

Table 33: Policy Responses in South Asia after Food Price Hike

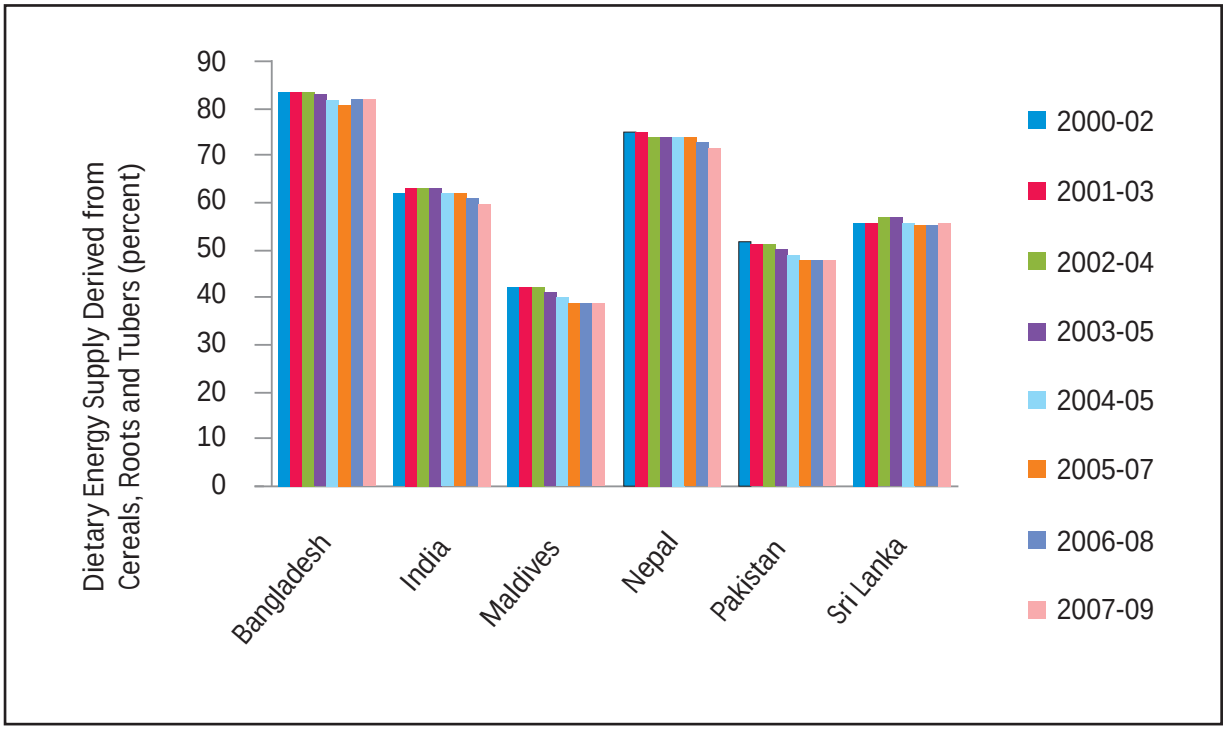
Country	Reduced Taxes on Food Grains	Stock Management	Export Restrictions	Pricing Policies	Cash Transfer	Food for Work	Food Ration/ Stamp	School Feeding
Afghanistan	✓					✓		
Bangladesh	✓	✓	✓ Imposed Ban on Rice Exports	✓	✓	✓	✓	✓
Bhutan	✓	✓		✓	✓			✓
India	✓	✓	✓ Imposed Ban on Wheat and non-Basmati Rice Exports, and High Taxes on Basmati Rice Exports	✓		✓	✓	✓
Maldives	✓	✓		✓	✓			✓
Nepal			✓ Imposed Ban on Rice Exports			✓		✓
Pakistan		✓	✓ Imposed Ban on Wheat Exports	✓	✓			
Sri Lanka	✓		✓	✓	✓		✓	✓

Source: World Bank (2008)

4.5.5 Changes in Food Composition

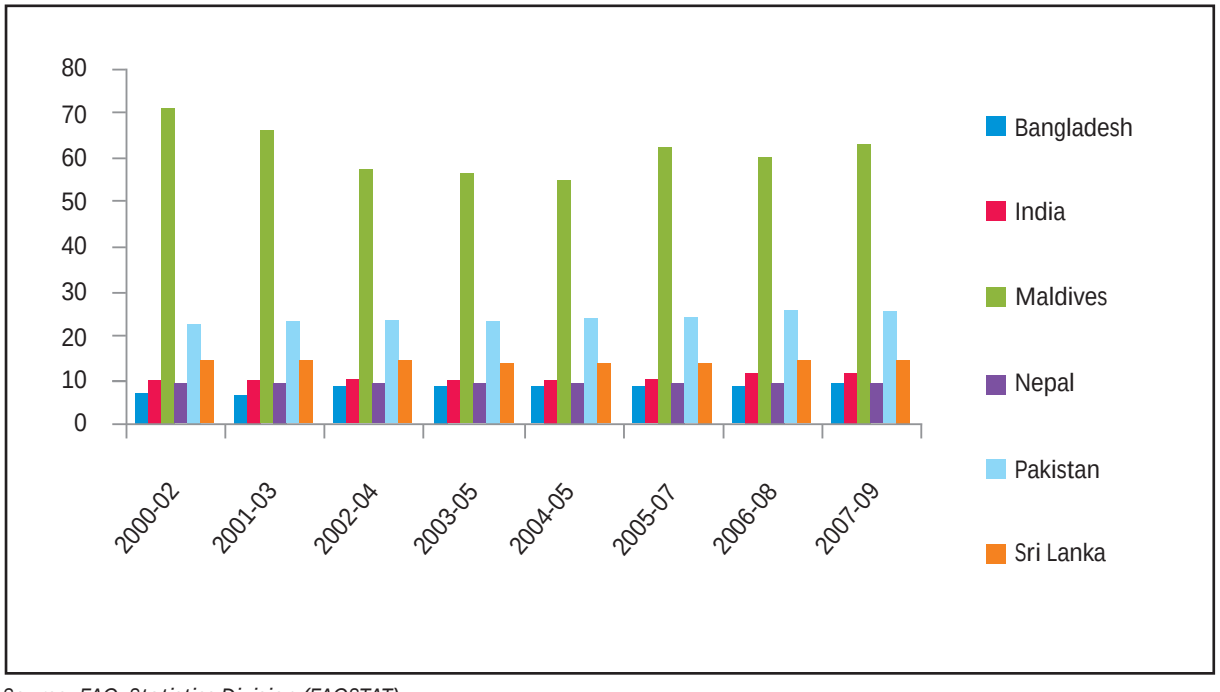
Along with a rise in dietary energy supplies, changes have been observed in the composition of diets. Globally, the share of cereals, roots and tubers in the diet has declined. On the other hand, there has been a growth in the consumption of animal source goods with the economic growth since the 1960s. South Asia has also shown a shift in diet composition, although this shift is not very significant.

Figure 45: Share of Dietary Energy Supply Derived from Cereals, Roots and Tubers



Source: FAO, Statistics Division (FAOSTAT)

Figure 46: Average Protein Supply from Animal Origins



Source: FAO, Statistics Division (FAOSTAT)

4.5.6 Undernourishment in South Asia

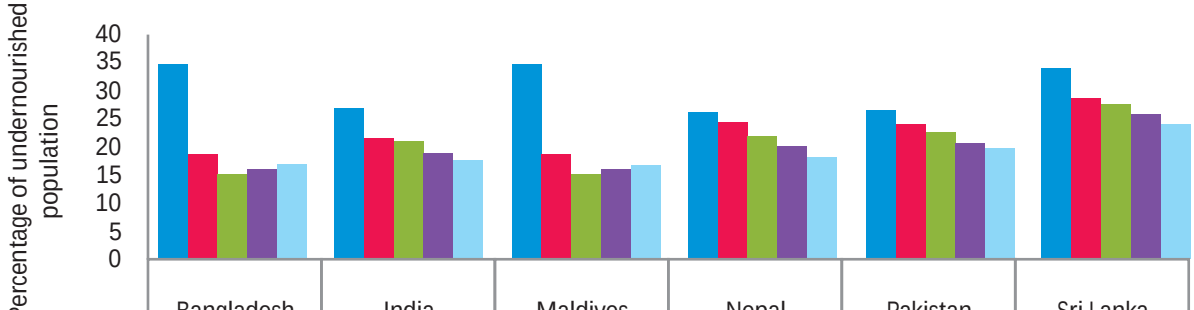
Despite the economic growth, about 870 million people around the world remained undernourished in the period 2010-12, representing 12.5 percent of the global population. Of these people, 852 million were reported to be the citizens of developing countries. Even though a steep decline in the prevalence of undernourishment was observed until 2007-08, these numbers were still unacceptably high. Also, the rate of decline in undernourishment has lowered since 2007-08.

Table 34: Number (in Millions) and Prevalence (Percent) of Undernourishment

Regions	1990-92	1999-2001	2004-06	2007-09	2010-12
Western Asia	8	13	16	18	21
	6.6	8	8.8	9.4	10.1
Southern Asia (Including Iran)	327	309	323	311	304
	26.8	21.2	20.4	18.8	17.6
Caucasus and Central Asia	9	11	7	7	6
	12.8	15.8	9.9	9.2	7.4
Eastern Asia	261	197	186	169	167
	20.8	14.4	13.2	11.8	11.5
South-Eastern Asia	134	104	88	76	65
	29.6	20	15.8	13.2	10.9

Source: FAO, WFP and IFAD (2012)

Figure 47: Prevalence of Undernourishment in South Asia



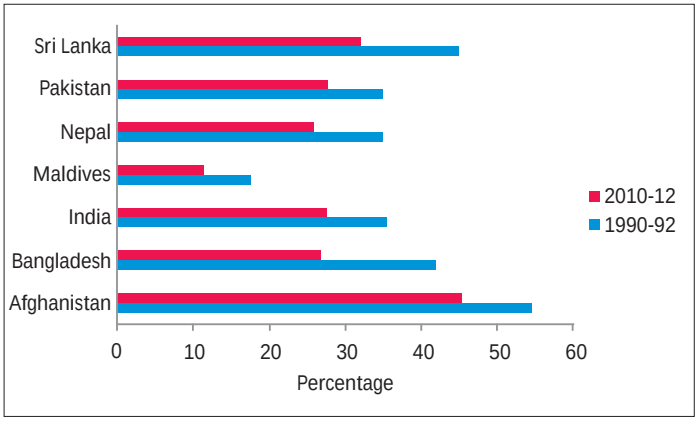
	Bangladesh	India	Maldives	Nepal	Pakistan	Sri Lanka
1990-92	34.6	26.9	10.9	25.9	26.4	33.9
1999 - 01	18.4	21.3	9.5	24.5	24	28.7
2004 - 06	15.1	20.9	10.1	21.7	22.8	27.9
2007 - 09	16.1	19	7.4	20.1	20.8	25.7
2010 - 12	16.8	17.5	5.6	18	19.9	24

Source: FAO, WFP and IFAD (2012)

Despite the decline in the number of undernourished in South Asia, its share with respect to the world has witnessed an increase from 32.7 percent to 35 percent from 1990-92 to 2010-12. The observed slowdown in the reduction of hunger rates after 2007 varies from region to region.

Food inadequacy is a part of FAO's set of indicators of food security. Prevalence of food inadequacy indicates the risk of individuals living on a diet that prevents them from effectively carrying out an economic activity requiring significant physical effort. The prevalence of food inadequacy also includes individuals with a food energy deficit, who may not be considered undernourished under normal conditions. However, they may become undernourished while carrying out intense physical work. The graph below depicts the prevalence of food inadequacy in the region. A considerable portion of population in the region, especially Afghanistan, suffers from inadeqaute food intake.

Figure 48: Prevalence of Food Inadequacy in the Region



Source: FAO (2013)

4.5.7 Anthropometric Indicators

These indicators convey information on the most long-lasting consequences of chronic and acute undernourishment. Stunting is the outcome of prolonged inadequate nutrition and/or repeated infections; wasting stems from acute malnutrition; and, low body weight reflects a combination of chronic and acute malnutrition.

Over the 2005-2011 period, stunting rates exceeded 40 percent in South Asia, with peaks in Nepal and India. This is considered a very high prevalence rate by WHO.

Table 35: Outcomes of Inadequate Nutrition in Percent Children below the Age of Five Years (from 2005-11)

Countries	Underweight	Stunted	Wasted
Bangladesh	41.3	43.2	17.5
Bhutan	12.7	33.5	5.9
India	43.5	47.9	20
Maldives	17.8	20.3	10.2
Nepal	38.8	49.3	12.7
Sri Lanka	21.6	19.2	11.8

Source: FAO (2013)

4.5.8 Fisheries and Aquaculture

Fisheries play an important role in food and nutritional security of a country. They make a significant contribution to the supplies of animal proteins across the world. Consumption of fish provides a range of nutrients including proteins and energy. The proportion of animal protein that comes from fishes is high for a few South Asian countries. 71 percent of the animal protein comes from fishes in Maldives and 56 percent in Bangladesh. They also contribute significantly in reducing micronutrient deficiencies. A few species of fishes are excellent sources of many minerals like iodine, selenium, zinc, iron, calcium, phosphorous and potassium and vitamins such as A, D and B. Fishes are also sources of long-chain omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which help in the brain and neural system development of children.

The annual fish consumption in South Asian countries is low. In India, the national average annual consumption of fish and fish products is 2.85 kg/capita. This accounts for 2.2 percent of the total protein consumption. However, the consumption levels vary within the country as well. They range from 22.7 kg/capita in Kerala to 0.03 kg/capita in Himachal Pradesh. The annual fish consumption of Pakistan is even lower than India's consumption. It was merely 0.06 kg/capita in 2011. Sri Lanka has one of the highest

consumption figures. The average annual consumption figure of fish and fish products was 15.3 kg/capita in 2010. Although the annual fish consumption is low, large population size of a few countries resulted in higher consumption figures. For example, in India more than 3.4 million tonnes of fish is consumed every year (FAO 2014).

4.5.9 Measures to Enhance Food Security

Policy measures aimed at improving direct access to food and nutritional status have conventionally been employed by the South Asian countries in order to reduce the food insecurity and banish malnourishment in the region. These policies target different factors affecting the food security such as demographics, agriculture, climate change etc.

Research and Development for Enhanced Agricultural Productivity

Meeting the demand for food is extremely crucial for the food security in the region. A cocktail of agricultural practices like conservation agriculture, high yielding cultivars and efficient use of fertilizers should be promoted. In order to increase the productivity in the region, it is imperative to increase the expenditure on the R&D of agricultural sector. R&D should focus on technological innovations to improve agricultural productivity through practices and technologies. Practices can focus on achieving high yield through improvements and greater efficiency in the current agricultural practices like zero tillage agriculture and rain-fed crop systems (UNESCAP 2012). Focus should be on developing varieties with higher tolerance to abiotic stresses like salinity, flood, drought etc and increased resistance to pests and insects. Development of varieties that can adapt to changing climatic conditions, like the fluctuations in temperature and precipitation, should be a priority. The potential of agro-ecology in the region should also be explored. R&D should also focus on water and natural resource management techniques, technology exchange- exchange of germplasm; exchange of variety and breed, crop and animal husbandry practices, water and natural resources management techniques, pest control etc.

Biotechnology can play a major role in improving the crop productivity and developing disease and stress resistant varieties. It can also be used to improve the nutritional content of the crops. An example of a genetically modified crop is the Bt crop, especially cotton, which is being cultivated in India and Pakistan. However, various biosafety issues are associated with GMOs as demonstrated in the case of Bt Brinjal. Adequate and transparent safety procedures have to be employed by the country in order to control the risks associated with the use and release of GMOs in the environment.

Bangladesh has also invested in agricultural research. In 2007 and 2008, Bangladesh government allocated special funds for agricultural research. A project entitled National Agricultural Technology Project (NATP) is being implemented in Bangladesh. The government has also encouraged private sector and NGO participation in the development and promotion of hybrid varieties. One of the initiatives taken up in Maldives is the Hydroponics Agriculture Pilot Project. The project aims to promote the development of hydroponics production system (which is a technique of growing plants without soil, in water containing nutrients), both by households and on a commercial scale, to help the country achieve food security as well as provide its citizens with an additional avenue of employment and income generation. The project also aims to increase the availability of high-quality horticultural products. The Department of Agricultural Research and Education (DARE) coordinates and promotes agricultural research and education in India.

Another area of research could focus on developing institutional capacity for sharing of information on better technologies to agricultural producers. Knowledge can also be provided on various other agricultural issues like land and water management, nutrient management, sustainable agriculture and others. Network for Knowledge Transfer on Sustainable Agricultural Technologies and Improved Market Linkages in South and Southeast Asia (SATNET) aims at supporting intra-regional learning on sustainable agriculture technologies and trade facilitation (UNESCAP 2012).

Simultaneously, the efficiency along the whole food chain should be improved by reducing food wastage and spoilage by improving the transport, storage and distribution infrastructure. Behavioural change among wealthier societies is also necessary to reduce the food wastage (UNEP 2012).

Regional cooperation provides an opportunity for the region to pool in resources for R&D for greater food

productivity and availability. Joint agricultural research programmes can benefit from better testing conditions for new crops and hybrids. In addition, regional cooperation can also reduce the investment costs in acquiring and maintaining advanced agricultural and technological equipment. Emphasis should be information and knowledge sharing on transboundary issues. The SAARC Regional Centre is one such example of cooperation in agricultural research in the region (UNESCAP 2012).

Strengthening the Public Distribution System

The countries of the region have a long history of distributing food grains to the poor households at below-market prices. All countries in this region have instituted the Public Distribution System (PDS) to achieve this objective. In fact, PDS is run through food procurement in the domestic market at a pre-announced procurement price, although imports have been resorted to in some countries like Bangladesh and Sri Lanka. Food grains are distributed through PDS (or 'fair-price' shops) at the "issue price" which is generally lower than the market price. As the gap between procurement and issue prices is usually narrow, the State subsidizes the PDS operations. It is crucial to strengthen the operational PDS systems in the region.

The Bangladesh government distributes rice and wheat under the Public Food grain Distribution System (PFDS), both through monetised channels like Essential Priority (EP), Other Priority (OP), Large Employee Industries (LEI), Flour Mill (FM), Open Market Sales (OMS), and Fair Price Card (FPC) and non-monetised (targeted) channels like Food for Work (FFW), Test Relief (TR), Gratuitous Relief (GR), Vulnerable Group Development (VGD), Vulnerable Group Feeding (VGF), Food for Education (FFE) and other relief channels. India's food distribution system is the largest managed food market system in the world. Food Corporation of India (FCI) oversees the implementation of PDS in India. Food distribution systems are being implemented in Afghanistan and Nepal, with the support from donor agencies like the World Food Programme. Sri Lanka switched from food delivery through PDS to food stamps. The Thriposha programme is a programme of food supplementation in which cereals, pulses and micro-nutrients are distributed free of cost to mothers in low-income groups, with children below the age of one. Nepal Food Corporation (NFC), a public sector organization, has been distributing food to the deficit hilly and mountain areas, for which the government extends transport subsidies.

However, PDS are difficult to manage and impose large costs in terms of inefficiency and waste. Conditional food programmes are better suited to improve the food insecurity in the region. Afghanistan, Bangladesh, India and Nepal offer food for work-in unskilled labour for public works and related work. Bhutan, India, Maldives, Pakistan and Sri Lanka use the avenue of education to offer food to the students and their families, on the condition of the child's attendance. Such programmes seek to improve targeting of food assistance and distribution through self-selection (UNESCAP 2012).

Food Reserves

Food reserves and banks are yet another alternative for increasing food security in the region. Different types of banks can be established. Grain, seed or fodder banks can serve as a source of storage, variety and diversity to countries. They can also act as a store of grains for households to draw upon in the times of food scarcity. Seed banks can store high-yielding seeds that farmers can access and return with interest over future crop seasons. Traditional bank reserves can also be made operational for earmarking cash reserves for use in times of crisis.

Role of Trade

Trade in food commodities plays a decisive role in ensuring food security in the region. It also helps in stabilising food prices while improving the availability and access to food. SAARC Countries need to define the role of regional food trade as well as trade in food with other countries.

However, few steps have already been taken towards regional cooperation. One such step was the establishment of South Asia Preferential Trade Area (SAPTA). Later, the South Asia Free Trade Agreement (SAFTA) was put into place to overcome the shortcomings in SAPTA. Another step was the establishment of the Food Bank. The Food Bank was to act as a regional food security reserve for countries during food shortages and emergencies, in order to provide regional support to national food security efforts, foster inter-country partnerships and regional integration, and solve regional food shortages through collective action. SAARC should immediately operationalize the food bank in the region.

Box 26: Village Grain Banks

The Village Grain Bank Scheme was launched in India in 1996 by the Ministry of Tribal Affairs for providing food grains in chronically food deficit areas, to be run by all living below the poverty line (BPL) and Antyodaya Anna Yojana families in the villages. During 1996-97, Village Grain Banks were established in 11 States and the Ministry of Tribal Affairs had released a sum of Rs. 10.26 crore for running 4858-grain banks upto 2004-05. The main objective of the scheme is to provide safeguard against starvation during the period of natural calamity or during the lean season by lending grains for stocking for an average of forty families. Grain Banks have to be set up in food scarce areas like the drought prone areas, the hot and cold desert areas, and tribal and inaccessible hilly areas.

Village Panchayat/Gram Sabha, self-help groups or NGOs identified by State Government will be eligible for running the grain banks. Central government has issued sanction for the establishment of 3282 grain banks in seven states in 2006, namely Andhra Pradesh, Orissa, Madhya Pradesh, Chhattisgarh, Jharkhand, Tripura and Meghalaya. In May 2006, a proposal for establishing 500 grain banks in Uttar Pradesh has been sanctioned.

Source: www.dfpd.nic.in

Fiscal Policies

Food price subsidies are a common response to food insecurity in the region. Even though subsidies are easy to implement, they are difficult to subsequently eliminate after consumers and producers adapt to them. An alternative to this, as described by UNESCAP, is cash transfers to consumers and producers in need. Small-hold farmers who depend on expensive inputs for farm production or who require incentives to adapt to more productive farm technologies can be targeted. On the consumer side, transfers to such segments of the population should be avoided who can better adapt to fluctuating food prices.

Table 36: Policies Related to Food Security in the Region

Countries	Measures
Bangladesh	Public Food Grain Distribution System
India	• Public Distribution System • National Food for Work Programme • Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) • Mid-day Meal Scheme • Integrated Child Development Scheme • The Antyodya Anna Yojana • Launch of National Food Security Mission in 2007 • National Policy for Farmers • Rashtriya Krishi Vikas Yojana • National Food Security Bill
Nepal	• The National Agriculture Policy • The Food and Nutrition Security Plan • Food for Education Programme
Pakistan	• Benazir Income Support Programme • Food Support Programme
Sri Lanka	• Samurdhi Programme • Food Stamps • Thriposha Programme

Table 35: Policies Related to Food Security in the Region

Countries	Measures
Maldives	• Hydroponics Agriculture Pilot Project • Food Safety Advocacy Sessions
Bhutan	The key policy measures in Bhutan are to intensify and diversify production, to adopt an integrated approach for nutrient and pest management and to achieve at least 70 percent self-sufficiency in food grains with a focus on developing and promoting high-value, low-volume cash crops that offer comparative advantages over other crops in capturing the off-season markets in India and neighbouring countries; promoting the use and breeding of superior, healthy breeds of highly productive livestock; and, placing a higher priority on conservation than on commercial exploitation of forests.

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Photo Credit State of Environment Report, Uttar Pradesh

Scenarios and Outlooks

Chapter 5

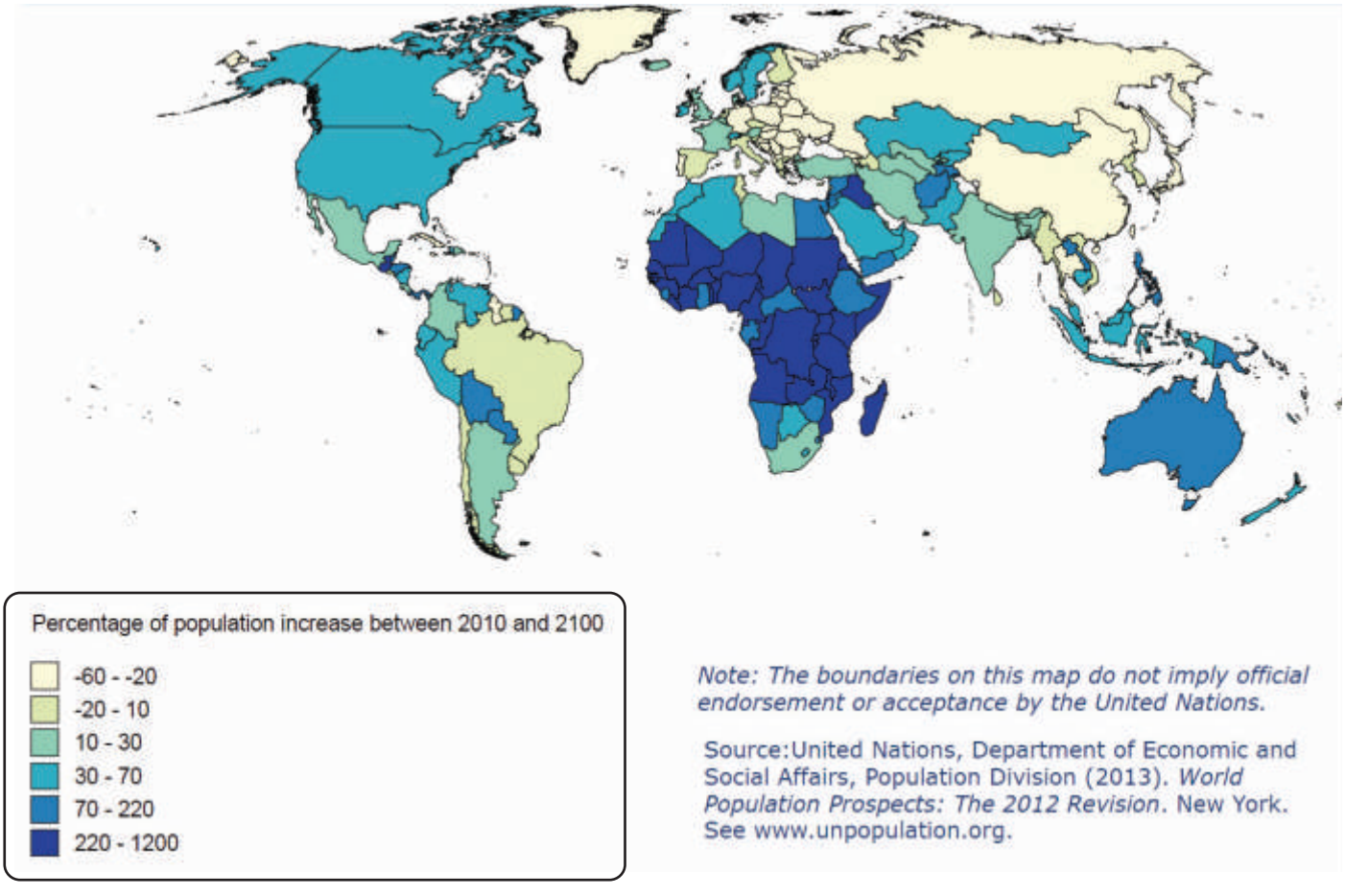
This section describes the possible state of key drivers and issues in the future. Possibilities are described for drivers i.e. population growth and economic development, and other concerns like state of biodiversity, land use, energy access, food security etc. These are drawn from existing scenario studies. Based on these future developments, possible cross-cutting responses are mapped out in the next section.

According to UNEP, scenarios are descriptions of journeys to possible futures. They reflect different assumptions about how current trends will unfold, how critical uncertainties will emerge and what new factors will come into play in the future. Scenarios paint pictures of possible futures, and explore the differing outcomes that might result if basic assumptions are changed (UNEP 2002). They illustrate the role of human activities and socio-economic indicators in future developments. Ultimately, it would certainly help in understanding the kind of policy changes required for a sustainable world.

5.1 Socio-economic Indicators

Population and economic growth are the two major drivers of change in the South Asian region. The global population is projected to grow to 11 billion by 2050 and to 15 billion by 2100 (UNDESA 2013). A large portion of population growth is expected to occur in low income countries, especially in Sub-Saharan Africa, Northern Africa, West Asia and South Asia. The population of South Asia was documented to be about 1.64 billion in 2012 (World Bank 2012). It is estimated that this population will depict an upward trend, ascending as high as 3.5 billion by 2100 (UNDESA 2013). Figure 49 shows the predicted percentage increase in the population from 2010 to 2100.

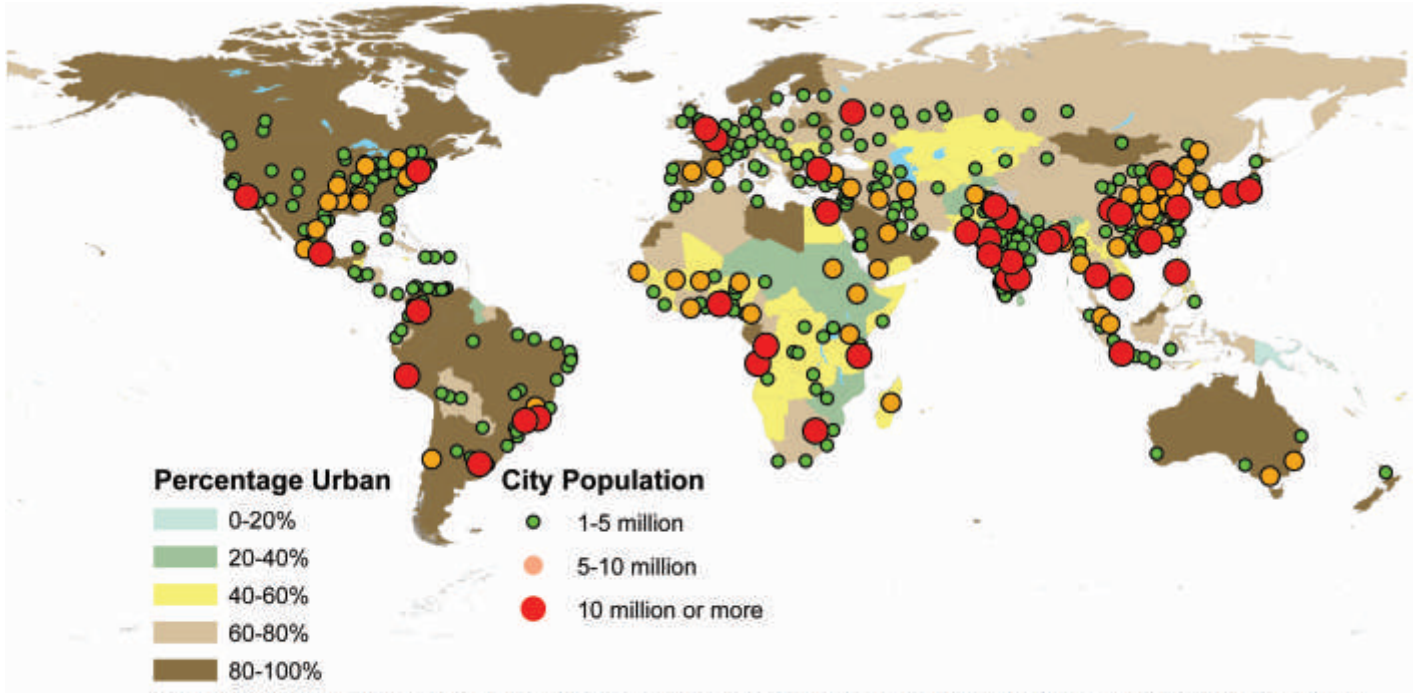
Figure 49: 'Maximum Population Growth'



Source: UNDESA (2013)

The maximum population growth is expected to occur in cities and towns of developing countries. Globally, the population living in urban areas is projected to reach an astronomical figure of 6.3 billion by 2050. The urban population of South Asia is estimated to grow to 1.12 billion by 2050. India, Pakistan and Bangladesh would be among the ten countries with largest increase in their urban population (as depicted in the figure below). By 2030, Ahmedabad, Bengaluru, Chennai and Hyderabad are projected to become megacities (UNDESA 2014).

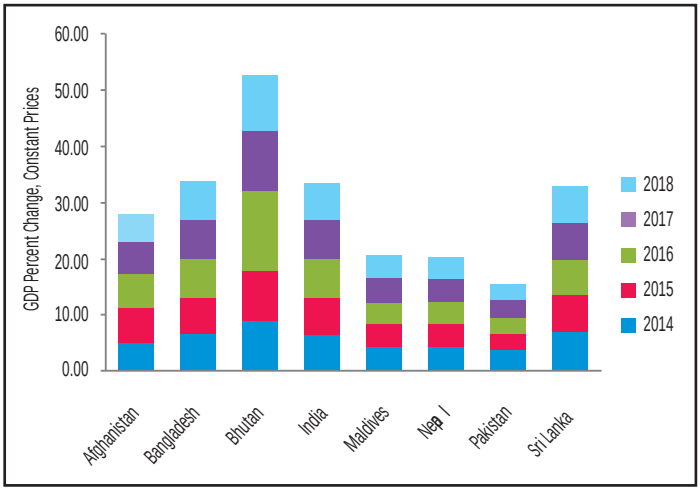
Figure 50: Percentage of Urban Population & Agglomerations by 2025



Source: UNDESA (2014)

GDP is an indicator of economic development. GEO-5 projects an increase in GDP with variation in global average per-person growth rates ranging between 1.2 and 2.2 percent annually. However, due to financial crisis, UN has forecasted that the World Gross Product (WGP) would remain at 2.4 percent in 2013 and 3.2 percent in 2014. The following graph depicts the percentage change in GDP in South Asian countries till 2018. Maximum growth could be witnessed in Bhutan (IMF 2013). In fact, India is set to become one of the largest economies of the world by 2050 along with China and US (PwC 2013).

Figure 51: Change in GDP of South Asia



Source: IMF (2013)

5.2 Greenhouse Gas Emissions

Globally, anthropogenic GHG emissions have increased since the pre-industrial times, with an increase of 70 percent between 1970 and 2004. The annual emissions of CO_2 have enhanced by about 80 percent between 1970 and 2004. A major portion of the anthropogenic emissions has come into existence due to fossil fuel burning. Land-use change, especially deforestation, also contributes significantly to the emissions (IPCC 2007a).

The GHG emissions in the future will be determined by various driving forces like demographics, socio-economic development and technological advancement. IPCC has come up with a number of long term emission scenarios, i.e. Special Report on Emission Scenarios (SRES). Four qualitative storylines yield four sets of scenarios called "families": A1, A2, B1, and B2 (explained in the following Box). One set of scenarios consists of six scenario groups drawn from the four families: one group each in A2, B1, B2, and three groups within the A1 family, characterizing alternative development of energy technologies: A1F1 (fossil fuel intensive), A1B (balanced), and A1T (predominantly non-fossil fuel).

Box 27: Emission Scenarios

A1 Scenario: It describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income.

A2 Scenarios: It describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which culminates into a continuous upsurge in the global population. Economic development is primarily regionally-oriented and the per capita economic growth and technological changes are more fragmented and slower than in other storylines.

B1 Scenario: It describes a convergent world with the same global population that peaks in the mid-century and declines thereafter (as in the A1 storyline) but with rapid changes in economic structures towards a service and information economy, with reductions in material intensity and introduction of clean and resource-efficient technologies. The emphasis is on global solutions to attain economic, social, and environmental sustainability, including improved equity without additional climate initiatives.

B2 Scenario: It describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population growing at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological changes than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

Source: www.ipcc.ch

The table below depicts the A1 emission scenarios for Asia.

Table 37: SRES A1 (AIM) Emission Scenarios for Asia

	2020	2030	2040	2050	2060	2070	2080	2090	2100
Anthropogenic Emissions CO_2 (GtC)	4.16	5.32	5.64	5.98	6.02	6.10	5.99	5.71	5.46
CH_4 Emissions (Mt)	171	207	210	214	183	156	138	127	117
N_2O Emissions (Mt)	2.7	2.8	2.9	3.0	2.9	2.9	2.9	2.9	2.9
SO_x Emissions (Mt)	54.2	45.6	19.8	8.4	7.9	7.5	7.1	6.7	6.4
HFC (MtC eq.)	45	92	153	224	292	292	285	275	262
CO (Mt)	360	430	460	492	506	520	555	614	678
NO_x (MtN)	16	19	19	19	17	16	15	14	13

Source: www.ipcc.ch

The Fifth Assessment Report of IPCC describes four different sets of scenarios. These scenarios present the results of different levels of emissions of greenhouse gases, from the present times to 2100 due to global warming. The RCPs are not new, fully integrated scenarios (i.e., they are not a complete package of socioeconomic, emissions, and climate projections). They are consistent sets of projections of only the components of radiate forcing that are meant to serve as input for climate modeling, pattern scaling, and atmospheric chemistry modelling. However, it doesn't indicate which policy or behavioural changes society could make that would lead to scenarios. These RCPs are named on their radiative forcing target level for 2100. RCP2.6 is a low emissions scenario. The RCP8.5 is representative of the high range of non-climate policy scenarios. RCP4.5 and RCP6.0 are intermediate scenarios which assume stabilization in emissions (Van Vuren *et al.* 2011; CDKN 2014).

Apart from IPCC, countries have also conducted studies to assess their GHG emission profiles. The following table summarizes the results of five studies conducted in India:

Table 38: GHG Emissions Profile of India

	NCAER CGE Model	TERI MoEF Model	IRADe AA Model	TERI Poznan Model	McKinsey India Model
GHG emissions in 2030-31 (CO_2 or CO_2e) in billion tonnes	4.00 billion tonnes of CO_2e	4.9 billion tonnes (in 2031-32)	4.23 billion tonnes	7.3 billion tonnes in 2031-32	5.7 billion tonnes (including methane emissions from agriculture); ranges from 5.0-6.5 billion tonnes if GDP growth rate ranges from 6-9 percent
Per capita GHG emissions in 2030-31 (CO_2 or CO_2e)	2.77 tonnes CO_2e	3.4 tonnes of CO_2e (in 2031-32)	2.9 tonnes CO_2e	5.0 tonnes CO_2e (in 2031-32)	3.9 tonnes CO_2e per capita (2030)

Source: Climate Modelling Forum (2009)

India's GHG emissions would vary from four billion tonnes to 7.3 billion tones in 2031. However, the per capita emissions will stay under four tonnes per capita. Projection of GHG emissions for Bangladesh has been performed for the period 2005 to 2030, using the LEAP modeling programme. Approximately, 3.5 times increase over 2005 emissions could be observed. This amounts to 145,308 ktonnes of CO_2 equivalent. Electricity generation and industry are the two main GHG emitters in India (MoEF&CC 2012). Assuming an average GDP growth of 6.5 percent in 2011-15, under a Business as Usual (BAU) scenario, overall GHG Emissions (Mt CO_2 eq.) are projected to increase from 347 in 2011 to 4621 in 2050. Energy sector would be the highest contributor to these emissions (Khan *et al*. 2011).

5.3 Climate Change

Climate change is a significant threat due to the vulnerability of key socio-economic and development sectors. Long-term global scenario analysis is an important tool for the assessment of climate change. IPCC established by the World Meteorological Organization and the United Nations Environment Programme, provides an assessment of all the aspects related to climate change.

Temperature and Precipitation

Projections predict a likely increase in the area-averaged seasonal surface air temperature and a percentage change in the area-averaged seasonal precipitation (with respect to the baseline period 1961 to 1990). Atmosphere-Ocean General Circulation Models (AOGCMs) anticipate a significant acceleration of warming over that observed in the 20th century (Ruosteenoja *et al.* 2003; Christensen *et al.* 2007). In general, projected warming over South Asia is higher during winters than during summers for all time periods. The AR4 models also indicate an increase in the

annual precipitation during this century. Summer precipitation is also likely to increase in the region. On the other hand, a decrease in precipitation has been predicted in December, January and February (IPCC 2007b).

The projections under Representative Concentration Pathways (RCP) scenarios in the 5th Assessment Report of IPCC are also similar to the projections described in AR4. Projections indicate that average annual temperatures could rise by more than 2°C over land in most of South Asia by the mid 21st century and exceed 3°C, up to more than 6°C over high latitudes above the late 20th century baseline, by the late 21st century under the RCP8.5 scenario. Mean changes in temperatures could rise by less than 2°C in the 21st century, except at higher latitudes, which could be up to 3°C under RCP2.6. Projections indicate that more rainfall will be very likely at higher latitudes by the mid 21st century under the RCP8.5 scenario and over southern areas of Asia by the late 21st century. Rainfall patterns are not likely to substantially change by at lower latitudes under RCP 2.6. However, it is likely to increase at higher latitudes (IPCC 2014).

It has been estimated that the mean annual temperature of Afghanistan will increase by 1.4 to 4°C by 2060s and by 2 to 6.2°C by 2090s. The projected rate of warming is more during the spring and summer and relatively uniform across the entire country. Rainfall is projected to increase by 10-20 mm by 2030s. However, mean annual changes in rainfall by 2090s reveal drier conditions in the country (NEPA 2013). As compared to the current climatic trends (1980-2009), by 2010-2039 the mean annual temperature of Bhutan will increase by ~0.8-1^{0}C. On the other hand, by 2040-2069, the mean annual temperature will increase by around 2°C. In the context of precipitation, a moderate increase of about six percent during 2010-2039 and between 21-25 percent-during 2040-2069 has been projected (NEC 2011).

In order to estimate the temperature and precipitation changes, Bangladesh developed a number of scenarios using *the 'SCENario GENerator'* (SCENGEN). For this analysis, two SRES emission scenarios (A2-AIM and B1-AIM) have been selected from the family of SRES scenarios. According to the A2 scenario, an increase in the mean annual temperature of 1.32°C would be observed by 2050s. On the other hand, an increase of 8.41°C has been predicted by 2050s in the B1 scenario. Mean annual precipitation is expected to increase by 8.10 percent in the A2 scenario and 8.41 percent in the B1 scenario by 2050s (MoEF 2012). Climate change projections of India were analyzed using A1B SRES scenarios by PRECIS model. Simulations were carried out for three time slices-2020s (2011-40), 2050s (2041-70) and 2080s (2071-98). There may not be a significant decrease in the monsoon rainfall except in some parts of the Southern peninsula. However, these projections indicate an increase in rainfall intensity over most of the regions in the country. On the other hand, simulations for 2020, 2050 and 2080s indicate a warming over the entire Indian subcontinent (MoEF&CC 2012b). All models and all scenarios project an increase in both the mean and extreme precipitation in the Indian summer monsoon (IPCC 2014).

The annual maximum daily temperature of Maldives is projected to increase by around 1.5°C by 2100 (Ministry of Environment, Energy and Water 2007). Under the A2 scenario, a mean temperature rise of 2°C has been predicted for the summer months (June, July, and August) by 2100 (Ministry of Environment 2011). Increase of mean annual temperature by an average of 1.2°C by 2030, 1.7°C by 2050 and 3°C by 2100 has been predicted for Nepal in a study by OECD. In summer months, an increase in precipitation by 15-20 percent has been also projected (Ministry of Environment 2010).

Extreme Events

A significant increase in the number of extreme weather events is projected in South Asia, along with East and South-East Asia (Lal, 2003; Walsh 2004). These weather events also include the heat wave and intense precipitation events and an increase in the inter-annual variability of daily precipitation in the Asia summer monsoon (Lal *et al*. 2000; May 2004; IPCC 2014). A 10-20 percent increase in tropical cyclone intensities has been anticipated with a rise in the sea-surface temperature of 2-4°C as compared to the current threshold temperature in the region (Knutson and Tuleya 2004). Storm-surge heights could be amplified as a result of stronger winds, increased sea-surface temperatures and low pressures associated with tropical storms. This could translate into an enhanced risk of disasters along the coastal regions. Endemic morbidity and mortality rates will also augment due to the diarrhoeal diseases primarily associated with floods and droughts.

In India, the daily extremes in surface air temperature may intensify in the future. The frequency of cyclonic disturbances may lessen towards the end of the century. However, it might be more intense in the future. The intensity of tropical cyclones in Maldives is also predicted to be enhanced by 10-15 percent. Also, the islands in the North-East of Maldives could face storm tides of 2.30 metres in height.

Sea-Level Rise

Global mean sea level will continue to rise in the 21st century under all the four RCP emission scenarios. The same is true for South Asian region as well. Maldives is the most vulnerable country in the region, with a land area that is less than one percent of the total area suitable for habitation. The maximum hourly sea level for Hulhulé is increasing by approximately 7mm/year. Events such as an hourly sea level of 70 cm above the mean sea level are likely to occur at least on an annual basis by 2050 in Maldives (Ministry of Environment, Energy and Water 2007). The scenarios for sea level rise in Bangladesh are described below. The table below depicts the projections in the sea-level rise during 2020, 2050 and 2080 for A2 and B1 scenarios. Sea-level rise in this time period is considered to be the rise after 2005.

Table 39: Projections for Sea-Level Rise in Bangladesh

Scenarios	Sea-Level Rise (cm)		
	2020	2050	2080
A2 Emission Scenarios	6	27	62
B1 Emission Scenarios	5	23	48

Source: MoEF (2012)

By 2050, the total inundated area under A2 scenario with 27 cm sea-level rise would be 19722 km^2. For 2080, with a 62 cm sea-level rise, the corresponding area is projected to be 21,839 km^2.

The expected rise in sea level implies increased risks for the coastal settlements of the region. The densely populated areas of India and Bangladesh will be worst affected. It will also increase coastal flooding, erosion and salt water intrusion into surface and groundwater. Mangroves, salt marshes, and seagrass beds will decline, unless they receive sufficient fresh sediment to keep pace or they can move inland (IPCC 2014). Sunderbans are highly vulnerable to sea level rise. A 96 percent decline in the tiger habitat is predicted with a 28 cm sea level rise if sedimentation does not increase surface elevations (Loucks *et al*. 2010).

5.4 Water Resources

The future projections of use of water resources depend not only on climate change but also on several other factors like population, land use, irrigation practices, construction of dams, economic policy, technological evolution like wastewater treatment and reuse and desalination, as well as the lifestyle. The projections take into account the availability of water resources as well as the demand of the society. Projection of the water resources, including the volume and variability of water resources, is of immense concern to the scientific community, government and the local public.

5.4.1 Irrigation

Water withdrawals for agriculture depend on the increase in irrigated land and change in irrigation density for each country. The irrigation area will increase in the future to feed the growing population. However, this will be limited by cropland availability. According to FAO, developing countries (with 75 percent of the global irrigated area) are likely to expand their irrigated area until 2030 by 0.6 percent per year, while the cropping intensity of irrigated land will increase from 1.27 to 1.41 crops per year, and irrigation water-use efficiency will increase slightly (Bruinsma 2003). Most of this expansion is expected to occur in the water stressed regions of the world, including South Asia. In another study, a 40 percent increase in irrigated areas by 2080s is projected using a revised A2 scenario and FAO projections. It is expected to occur in South Asia along with Africa and Latin America, with an average increase of 0.4 percent per year (Fischer *et al.* 2006).

5.4.2 Glaciers

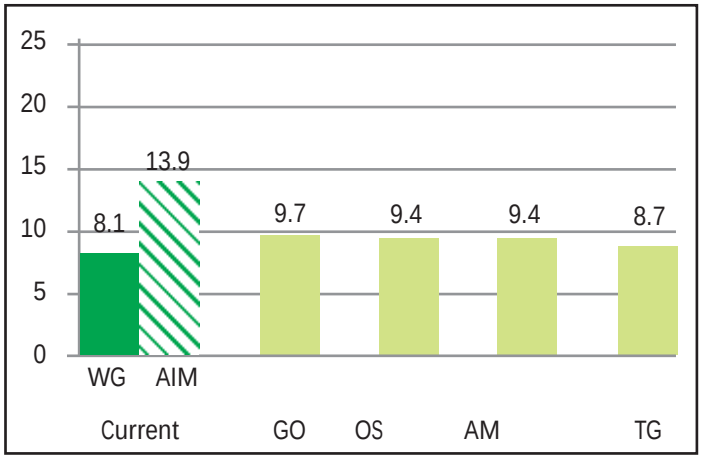
A continued mass loss from glaciers in the 21st century has been predicted. The mass loss projections for the Himalayas range between 2 percent gain and 29 percent loss to 2035. The range of losses varies between 15 to 78 percent by 2100 under the RCP4.5 scenario. The mean loss to 2100 is 45 percent under the RCP4.5 scenario and 68 percent under RCP8.5. Projections also indicate an increased run-off throughout the century in Kashmir and eastern Nepal (Immerzeel *et al.* 2013).

If the warming rate is constant, and if, ice melting per unit area increases and total ice-covered area decreases, the total annual yield passes through a broad maximum: "peak meltwater." Peak ice meltwater is reached in mid to late century, but increased precipitation overcompensates for the loss of ice (Cisneros *et al.* 2014).

5.4.3 Water Availability

Water availability is the total volume of water that is annually renewed by precipitation and theoretically available to support society's water uses and the needs of freshwater ecosystems. At present, the global availability of water is estimated to be 42,600-55,300 km^3 per year (MA 2005). Scenarios by the Millennium Ecosystem Assessment predicted the water availability of Asia in 2100 under different scenarios and compared them with Water Gap (WG) and AIM scenarios as per the figure below.

Figure 52: Water Availability in Asia in MA Scenarios in 2100 (thousand km^3 per year)



Source: MA (2005)

Table 40: Millennium Ecosystem Scenarios

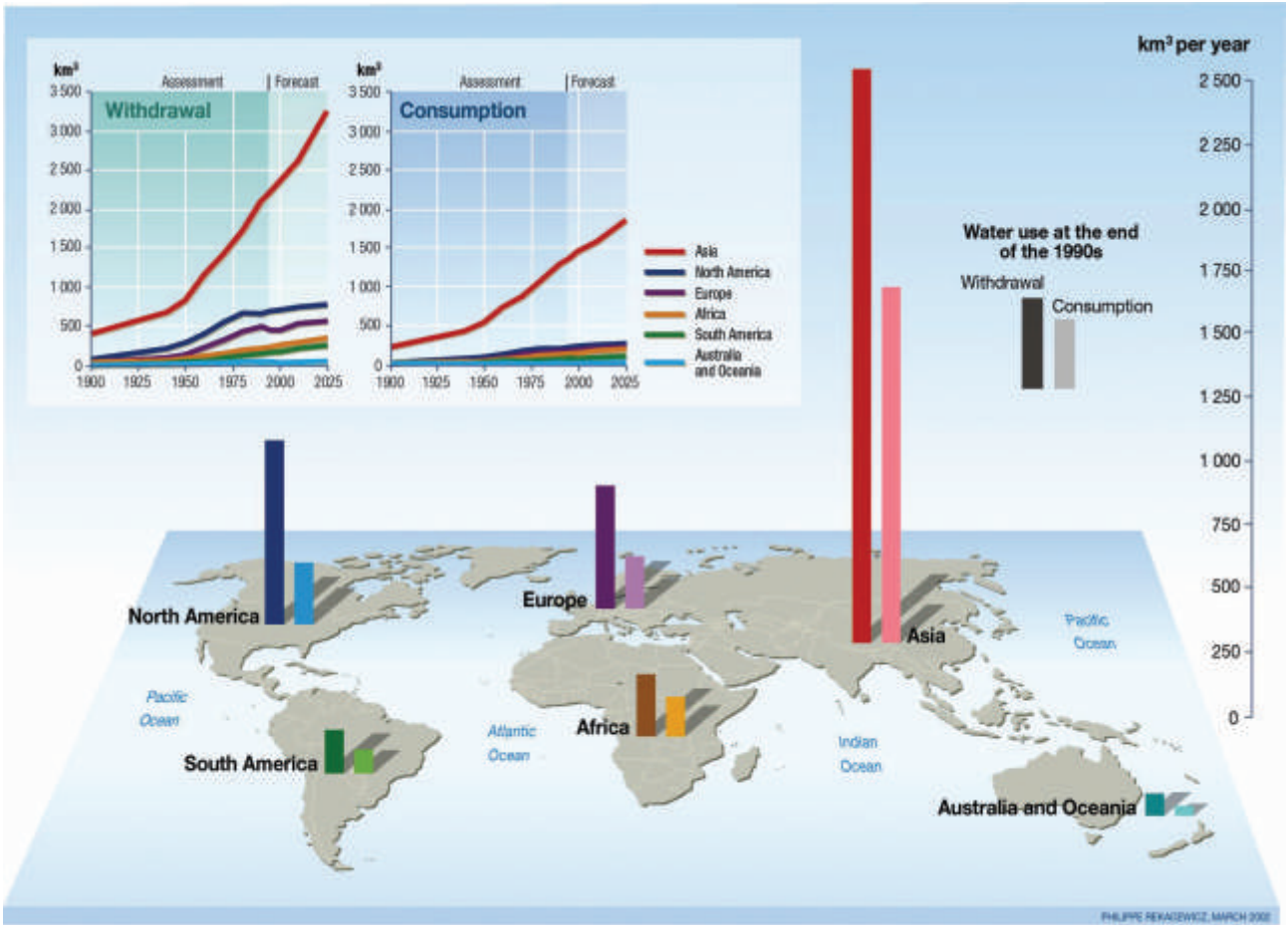
Scenario Name	Dominant Approach for Sustainability	Economic Approach	Social Policy Foci	Dominant Social Organizations
Global Orchestration (GO)	sustainable development; economic growth; public goods	fair trade (reduction of tariff boundaries); with enhancement of global public goods	improve world; global public health; global education	transnational companies; global NGO and multilateral organizations
Order from Strength (OS)	reserves; parks; national-level policies; conservation	regional trade blocs; mercantilism	security and protection	multinational companies
Adapting Mosaic (AM)	local-regional co-management; common-property institutions	integration of local rules regulate trade; local nonmarket rights	local communities linked to global communities; local equity important	cooperatives, global organizations
Techno Garden (TG)	green technology; eco-efficiency; tradable ecological property rights	global reduction of tariff boundaries; fairly free movement of goods; capital, and people; global markets in ecological property	technicla expertise valued; follow opportunity; competition; openness	transnational professional associations; NGOS

Source: MA (2005)

5.4.4 Water Use and Stress

Water withdrawal gives an estimate of the water utilized by the society to meet its domestic, industrial and agricultural needs. Annual global freshwater withdrawal has grown from 3,790 km^3 (of which the consumption accounted for 2,070 km^3 or 61 percent) in 1995, to 4,430 km^3 (of which consumption accounted for 2,304 km^3 or 52 percent) in 2000 (Shiklomanov 1999). The water withdrawals are expected to increase even further. The figure below depicts the increase in water withdrawal rates around the world, especially in Asia by 2000.

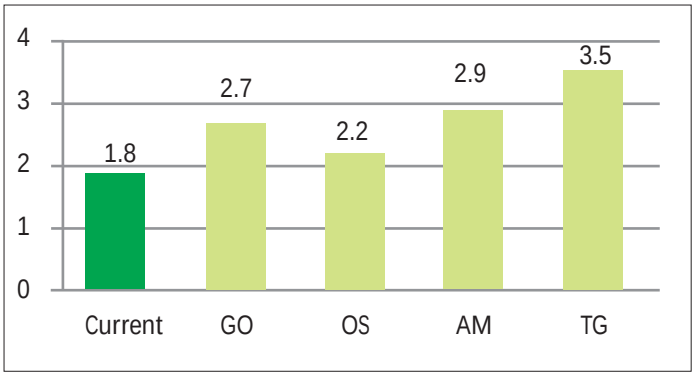
Figure 53: Water Withdrawal and Consumption Graph



Source: UNEP (2008)

The MA Scenarios project an increase in water withdrawals in all the four scenarios. Maximum withdrawal can be witnessed in 2050 in the Order from Strength scenario for Asia (MA 2005).

Figure 54: Water Withdrawals in MA Scenarios in 2050 (thousand km³ per year)

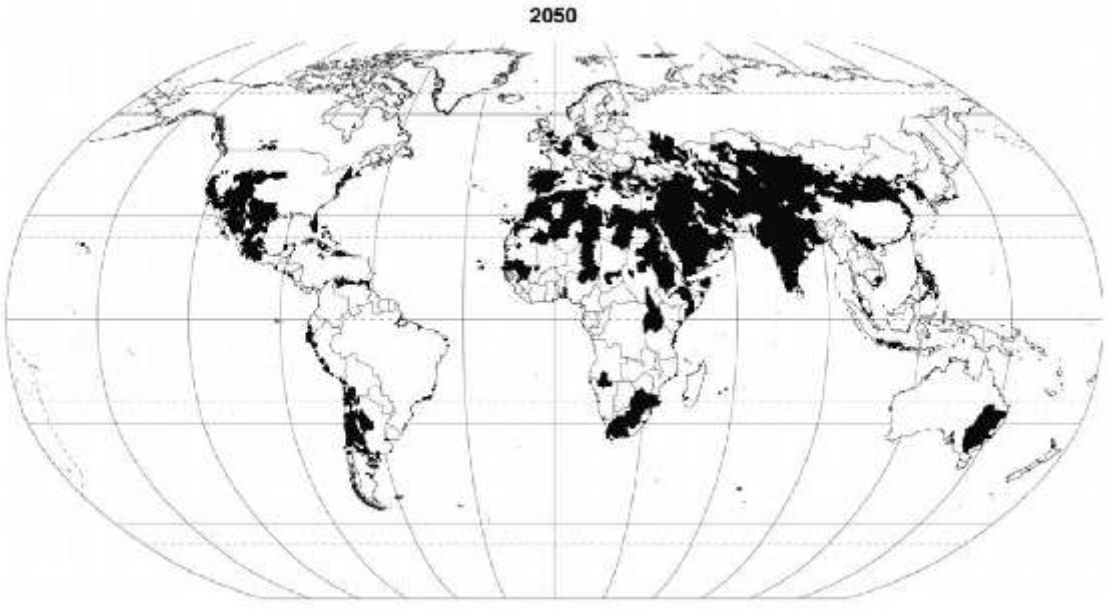


Source: MA (2005)

Due to the increase in water withdrawals, the pressure on water resources will increase immensely leading to tremendous stress. Water stress is also used to obtain an estimate of the extent of the society's pressure on water resources (Cosgrove and Rijsberman 2000). An indicator of stress is the water withdrawal to the availability ratio. When the annual per capita renewable freshwater availability is less than 1,700 cubic metres, countries begin to experience periodic or regular water stress. If the water availability goes below 1,000 cubic metres, water scarcity begins to hamper the economic development and human health.

MA scenarios predict the South Asian region to be severely water stressed in 2050, according to the GO Scenario. IPCC also predicts the expansion of areas under severe water stress in South Asia (IPCC 2007b).

Figure 55: Areas under Water Stress in 2050



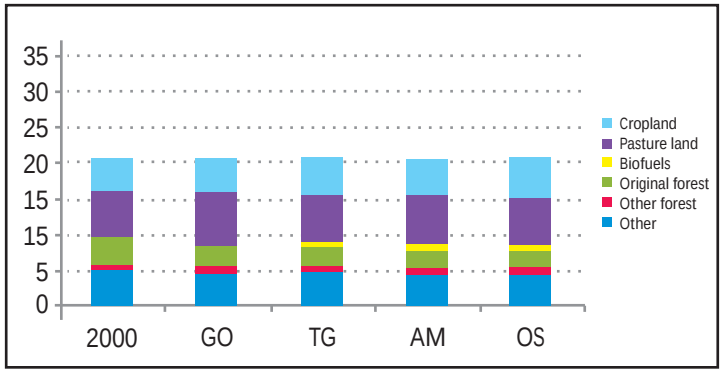
Source: MA (2005)

5.5 Land Use

Land use changes are not easy to predict through models since these changes evolve from diverse human activities that are heterogeneous in spatial and temporal dimensions. They also depend strongly on local environmental conditions and ecological processes.

The land use pattern of Asia in 2050 as projected by MA is depicted in the figure 56:

Figure 56: Land Use Pattern of Asia in 2050 (Asia area in million Km^2)



Source: MA (2005)

Photo 37: Changes in Land Use Pattern Including Decrease in Forest Area are Expected to Occur by 2050

Photo Credit: Nabin Baral, ICIMOD

MA scenarios predict a decrease in the forest area till 2050 in Asia. Forest area is classified into 'original forests' and 'other forests'. Original forests are defined as forests that were present in 1970s and have not changed their attributes through either expansion of agricultural land, timber production or climate change since then. Other forests are those grown on abandoned agricultural or other kind of land, or have been established on other types of land due to climate change.

5.5.2 Agricultural Production

IPCC predicts a decrease up to 30 percent in crop yield in South Asia, using the HadCM2 model. The combined effect of thermal stress and water scarcity in the region would result in a decrease in the rice production in Asia by the end of 21st century. The net cereal production in South Asian countries is projected to decline between four to ten percent by the end of this century, under the most conservative climate scenario (Lal 2007).

In Bangladesh, production of rice and wheat might drop by 8 percent and 32 percent, respectively, by the year 2050 (Faisal and Parveen 2004). Substantial losses in rain-fed wheat in South Asia has also been predicted. For example, a 0.5°C rise in winter temperature would reduce the wheat yield by 0.45 tonnes per hectare in India (Lal *et al.* 1998; Kalra *et al.* 2003). More recent studies suggest a two to five percent decrease in the yield potential of wheat and maize for a temperature rise of 0.5 to 1.5°C in India (Aggarwal 2003). In the mountainous Swat and Chitral districts of Pakistan, there were mixed results as well. Projected temperature increases of 1.5 and 3°C would lead to wheat yield declines (by 7 percent and 24 percent respectively) in Swat district but to increases (by 14 percent and 23 percent) in Chitral district. In India, climate change impacts on sorghum were analyzed using the InfoCrop-SORGHUM simulation model. A changing climate was projected to reduce monsoon sorghum grain yield by 2-14 percent by 2020, with worsening yields by 2050 and 2080. In the Indo-Gangetic Plains, a large reduction in wheat yields is projected, unless appropriate cultivars and crop management practices are adopted. Mean changes in yield by the 2050s across South Asia of 16 percent for maize and 11 percent for sorghum was projected. Rice yield is also projected to decrease. The northern part of South Asia is particularly vulnerable to the impact of climate change on the yield of rice (IPCC *et al*. 2014).

5.7 Access to Clean Energy

International Energy Agency (IEA) projects the number of people without access to electricity to decline to just over 990 million people in 2030, which will be around 12 percent of the global population at that time. The number of people without any access to electricity in developing countries of Asia is projected to dip down to nearly half, diminishing from around 630 million in 2010 to below 335 million in 2030. Despite South Asia showing significant improvement in this domain, India will still have the largest population without access to electricity in 2030, at around 150 million (IEA 2012).

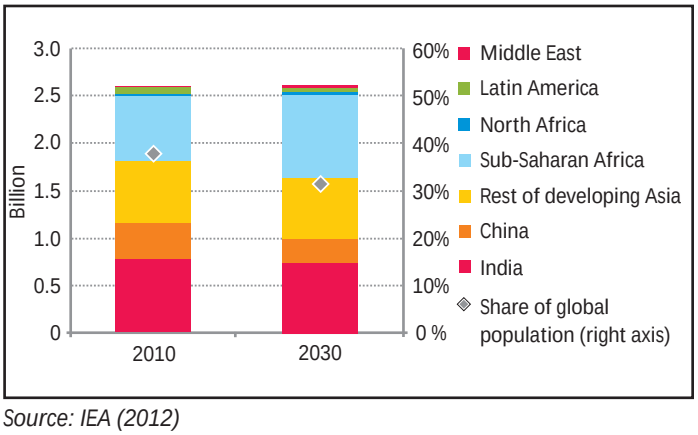
Table 41: Number of People without Access to Electricity in 2030 (in Millions)

Developing	Rural	Urban	Total	Share of Population
Developing Countries	879	112	991	15 percent
Developing Asia	305	29	334	8 percent
China	0	0	0	0 percent
India	144	8	153	10 percent
Rest of Developing Asia	161	20	181	14 percent

Source: IEA (2012)

IEA also projects a reduction in the total number of people without access to clean cooking facilities by 2030 – amounting to around 175 million. India, along with China, accounts for the improvement in the region. Nevertheless, India will still have nearly 30 percent of the global population without clean cooking facilities in 2030 (IEA 2012), as depicted in the figure below.

Figure 57: Number of People without Clean Cooking Facilities



Source: IEA (2012)

5.8 Conclusions

Population growth is a major driver of change in the South Asian region. Currently, a population boom could be observed in the region. This is expected to continue in the future as well ascending as high as 3.5 billion by 2100. The maximum growth is expected to occur in the towns and cities of the developing countries of the region. The population of South Asia is highly vulnerable to climate change. With the impacts of climate change projected to intensify in the future, the population of South Asia will face several challenges on account of water scarcity, food insecurity, disaster management and others. Keeping this in mind, it is extremely crucial for the countries to devise a clear roadmap to introduce strategies to address these concerns.

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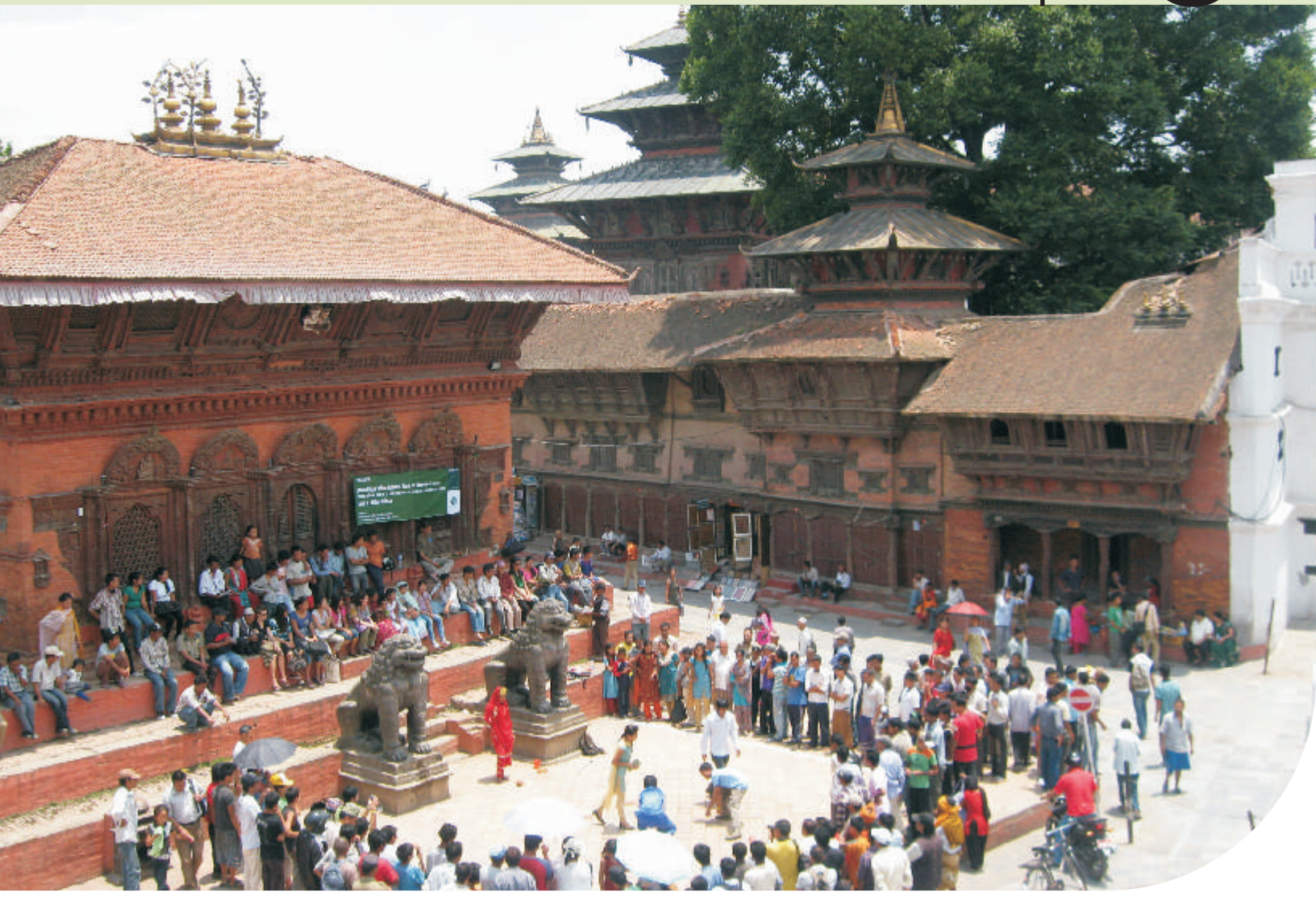
Options for Environmental Action

Chapter 6



Section VI presents the various policy and institutional options to cater to the emerging challenges of the region. The suggested cross-cutting options could be effectively utilized to address the previously discussed challenges.

The major drivers of change identified in the region of South Asia include the unplanned population growth and urbanization, unbalanced economic development and unsustainable production and consumption. These drivers of change impede the holistic development of the region. Increasing population growth and demographic changes are directly impacting the region like land degradation, resource depletion, dwindling food security, air quality degradation etc. Rapid industrialization in the region at present is also leading to emissions in the form of oxides of sulphur, nitrogen, and greenhouse gases. Incidentally, a number of subsidies implemented by the South Asian governments for supporting the under-privileged have a detrimental effect upon the environment as they have encouraged the unsustainable consumption of resources.

These drivers of change have a detrimental effect on the food, water and energy security in South Asia. The region is under the grave threat of concurrent crisis of climate change, food security, water scarcity and energy security. Clearly, these drivers of change pose serious challenges to sustainable development in South Asia. The suggested cross-cutting options could be effectively utilized to address the above mentioned challenges in the region. However, it is imperative to design policy responses for addressing these drivers to ward off these pressures. This calls for appropriate policy interventions like family planning programmes, sustainable production and consumption, and the concept of GNP, rather than GDP. However, effective implementation of these innovative policies and programmes is vital to witness the optimum positive results.

6.1 Awareness Building

The lack of knowledge about the environment and the services provided by it as well as the impacts of the actions of common people on the environment is also responsible for its degradation. Mass awareness in terms of environmental education will go a long way in preventing such devastation and bringing an attitudinal change in the people towards environment. In short, sensitizing and empowering people to take decisions, at the local level, is an effective way of dealing with the environmental problems of South Asia. This has also been recognized as an important cross-cutting area of the objectives of Agenda 21.

Environmental Education can be imparted through formal as well as informal modes. Formal education entails imparting environmental education in schools and other activities such as visits to museums and parks. All the South Asian countries have incorporated environmental components in the school curriculum. Education at higher level is also gaining momentum as more and more universities are introducing environment-related courses. Communication media like television, movies, articles, newspapers, and radio can also be used to disseminate knowledge. NGOs and universities in some countries play a major role in training teachers and providing the material for formal environmental education.

Table 42: Ongoing Efforts of Environmental Education in South Asia

Environmental Education and Awareness Generation in Bangladesh	
Ministry of Education; Ministry of Environment and Forests	• Grades 3 to 5 have courses in Environmental Studies (Society) and Environmental Studies (Science). Various teachers' guides have been developed for these courses. • The National Environment Policy and National Plans have emphasized the importance of EE. • Universities offer courses such as Zoology, Botany and Geography with environmental themes. • In all, 400 science clubs have been established in schools across the entire country.
Environmental Education and Awareness Generation in Bhutan	
Ministry of Health; Ministry of Education; National Environment Commission	• Bhutan has developed a new approach to its primary education curriculum (up to Grade 3). • 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. • Royal Society for Protection has initiated nature clubs in every school of Bhutan, including tertiary education (in colleges).

Environmental Education and Awareness Generation in India	
Ministry of Environment and Forests; Ministry of Human Resource Development	• Environmental Education, Awareness and Training Scheme • National Environment Awareness Campaign (NEAC) • Eco Clubs and National Green Corps (NGC) • Global Learning and Observations to Benefit the Environment (GLOBE) • Non-formal Environment Education and Awareness Project • Central Government recognizes EE as a key to success of overall environmental strategy and decides to help in setting up a 'Centre of Excellence' • ENVIS (Environmental Information System)
Environmental Education and Awareness Generation in Maldives	
Ministry of Education; Ministry of Home Affairs, Housing and Environment	• The second National Environment Action Plan emphasises on environmental awareness. • A President's Environmental Award Scheme has been established for schools. • Grades 1 to 5 have Environmental Studies courses, with teachers' guides and reference materials. • Grades 8 to 10 have a Fisheries Science course. • Environmental clubs are active in schools.
Environmental Education and Awareness Generation in Nepal	
Ministry of Education; Ministry of Environment, Science and Technology; Environment Protection Council	Formal Education: from primary to secondary education Non Formal Education: • The Government of Nepal has published National Non–Formal Education (NFE) Curriculum. • *Dissemination of National Version of PLANET:* The material was useful for imparting knowledge, skill and positive attitude development towards environment. • PLANET I was for Water Pollution, similarly PLANET II on Forest and conservation, adopted by the Research Centre for Innovation and Development (CERID)
Environmental Education and Awareness Generation in Pakistan	
Federal Ministry of Education; Pakistan Environment Council; Federal Ministry of Environment	• 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. • The Karachi Institute of Environmental Studies offers an EE course in its Master's Degree Programme. • The proposal of establishing a Teachers' Centre for Excellence in EE at Islamabad has been approved. • A prototype curriculum and a teachers' manual for pre-service training programmes have been developed. • Several in-service EE training courses for governmental officials are organized. • Special programmes are run for"green" opinion leaders and religious leaders. • The DEEP (Daudpota Environmental Education Programme) Prize for outstanding work in EE has been established. • A 16-week training course spread over a period of two years is run for the government, NGO, business and military personnel under the LEAD (Leadership for Environment and Development) Programme. • Several hundred environmental clubs (nature clubs) have been established in schools nationwide.

Environmental Education and Awareness Generation in Sri Lanka	
Ministry of Education and Higher Education	• A course on 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. • The National Education Commission requires schools to contribute to "the evolution of a sustainable pattern of living". • Environmental Pioneer Brigades and Environmental Clubs have been established in schools. • Field Study Centres have also been established.

Environmental awareness includes the onus of religious institutions and responsibilities of large industries towards the environment as a part of corporate social responsibility. Generating awareness and providing cleaner alternatives and technologies should be a major concern for all the countries of the South Asian region. In this context, the sharing of information and technologies by research institutions, regionally and globally, is crucial.

Quite a number of programmes and initiatives of the South Asian countries rely on awareness generation to address the various drivers of change. For example, the awareness initiatives of family planning programmes in India include advertisements on national television by the National Rural Heath Mission. Information on birth control and sterilisation methods are also disseminated through these initiatives. Similarly, several other initiatives can be witnessed across the region.

Box 28: Science Express Biodiversity Special

Science Express Biodiversity Special (SEBS) is an innovative exhibition which was launched in India by the Ministry of Environment and Forests in 2012. Its main objective is to create awareness amongst masses and youth about the exceptional biodiversity of India. Of the 16 coaches of SEBS, eight are solely dedicated to showcasing the myriad biodiversity spread across all the bio-geographical zones of India through a variety of interactive exhibits, short films and videos that are shown on Plasma and LED TV screens, large format displays, kiosks, backlit panels, and so on. The remaining coaches have interesting and informative exhibits on Climate Change, Energy and Water conservation as well as topical issues in the sphere of science. The popular *Joy of Science Lab* is mounted in an exclusive coach wherein students are guided to perform various experiments and activities to understand the concepts of various themes projected in the train. Phase I of SEBS was launched on World Environment Day (5 June 2012) from Safdarjung, Delhi. During its first phase, which ended on 22 December 2012 at Ahmedabad, it made halts of 3-4 days duration each at 51 locations and over 23 lakh people, (including six lakh students and 32,000 teachers from 7,000 schools), enjoyed learning in a fun-filled way. The train was also stationed at Secunderabad during 9-19 October 2012 to facilitate the visit of the delegates to Conference of Parties (CoP-11). In its second phase, which was launched on 9th April 2013, the Science Express halted at 60 locations across India.

Source: www.moef.gov.in

Photo 38: School Children Visiting SEBS

Photo Credit: MoEF Annual Report 2012-13

Regional cooperation is extremely fundamental in awareness generation activities. Agenda 21 also reiterates the same. According to it, "Countries should cooperate with each other to produce educational tools that include regional environment and development issues and initiatives, using learning materials and resources suited to their own requirements." The potential of cooperation in South Asia is enormous, especially the sharing of experiences and learnings. This would result in saving of resources, time, manpower and finance. This has already been demonstrated by several initiatives like SACEP's Strategy and Programme I & II and UNEP's Network for Environmental Training at Tertiary Level in Asia and the Pacific (NETTLAP), which have facilitated the exchange of information among the countries of South Asia.

Role of Youth in Sustainable Development

Youth constitute a large segment of population in South Asia. In order to successfully tackle the environmental risks, it is imperative to actively involve the youth in the decision-making process. This would affect their lives today as well as in the future. Chapter 25 of Agenda 21, adopted at the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, also suggests the same. This includes taking inputs, organizing consultations to engage youth pro-actively. In fact, support should be provided for capacity building and awareness generation among the youth. More finance should be directed towards mass awareness and education of people, especially the youth, in the sphere of environment and related issues. Youth participation through government and non-government organizations is also vital for sustainable development of the region. The role of youth can be institutionalized in policy-making through advisory bodies such as youth councils. In the same vein, the role of South Asia Youth Environment Network (SAYEN) should be formalized to support youth involvement.

Box: 29 South Asia Youth Environment Network SAYEN

South Asia Youth Environment Network (SAYEN) brings together youth with a vision of promoting sustainable development in South Asia. Set up in July 2002, SAYEN is linked to TUNZA, UNEP's strategy for engaging young people in environmental activities and in the work of UNEP. Centre for Environment Education (CEE), India, hosts the Secretariat for SAYEN, which has membership from all the eight SAARC countries. SAYEN has a membership from over 5,000 individuals and organisations. UNEP's regional, regional and national Youth Advisors support the SAYEN secretariat at CEE in planning and implementing activities in the region. This gives the youth the opportunity to hone their leadership skills and for SAYEN, the rich pool of young creative individuals.

SAYEN has identified key goals for itself which include:

1. Mobilising youth for sustainable development in the South Asian region
2. Youth participation for advocacy on sustainable development in South Asia
3. Youth participation to influence decision-making processes at national and regional levels

The key activities of SAYEN are networking and information servicing; capacity building of youth on relevant issues, awareness generation and documentation of initiatives implemented by various organisations and groups. SAYEN members have also been instrumental in providing inputs to policy and have been active participants in the national, regional and international processes, the recent ones being Rio+20, post 2015 consultations. They also support sustainability-based action projects proposed by youth.

Source: www.sayen.org

6.2 Participatory Management

Community-based natural resource management initiatives, combined with policy reforms can prove an excellent and effective mechanism for improving access to resources, and enhancing the quality and productivity of natural resources. Participatory processes ensure dialogues among all the stakeholders and active participation by the community. The success of joint forest management in India, community forestry in Nepal, and irrigation user groups in India, Pakistan and Sri Lanka substantiate that social capital and participatory processes are as crucial to environmental protection as financial resources and development programmes.

Globalization can convey significant benefits of technological advancement from the developed world, and market access through improved communication and information. For implementation of such advancements, it is indeed necessary to involve local communities in selection and implementation of these technologies in order to implement them more effectively and extract maximum benefit out of them for long-term sustainable development. Apart from implementation of such technologies in the local context, it is also necessary to promote research and development to improve the scientific understanding on environmental issues.

Photo 39: Participation of Local Community in Natural Resource Management in Essential

Photo Credit: Development Alternatives

Participatory management assumes even greater significance while dealing with trans-boundary issues. The trans-boundary nature of global environmental problems suggests that mutual cooperation between countries is indispensable and one of the best approaches for addressing concerns effectively. Therefore, responding to environmental problems through prompt collective action could be an important means to generate trust and goodwill. Though there are several mechanisms for environmental protection regionally, there exists a need for more policies that address the nature of trans-boundary environmental problems and their impacts. To complement the existing institutional mechanisms, a network of regional institutions could be quite effective, by contributing to the creation of a better understanding of key issues; exchanging information among key institutions; and training as well as capacity building of appropriate stakeholders. A proper perception on the common environmental problems will result in common and politically compatible solutions, ensuring better cooperation between the countries of South Asia.

Box 30: Participatory Approach to Forest Management in India and Nepal

In India, about 22 million hectares of forests are under the Joint Forest Management programme, where more than 1,00,000 committees have been formed by forest-fringe communities to protect state-owned forest patches, receiving in turn a share of forest resources (MoEF&CC 2009). In conjunction with stringent legislation against the use of forest land for non-forestry purposes, JFM has helped stabilize the forest cover after decades of rapid deforestation (MoEF&CC 2009). Additional incentives for participation have been created by a constitutional amendment that mandates decentralization and devolution of power to local authorities at district, block and village levels.

In Nepal, community forests are handed over to forest user groups (FUG) for conservation and utilization. Over 15,000 community forest user groups are present have access to fuel wood and fodder, and are additionally provided with income-generating opportunities. Of this, 13,528 are affiliated with the Federation of Community Forestry Users, Nepal. Forest user groups develop their own operational plans, set harvesting rules, set rates and prices for products, and determine how surplus income is distributed or spent. Community forestry in Nepal has lead to an annual increase of 1.35 per cent over the period 2000 to 2005.

Source: http://www.unep.org/greeneconomy/SuccessStories/ForestManagementinNepal/tabid/29869/Default.aspx

6.3 Transfer of Environmentally Sound Technologies

Considering that South Asia is highly vulnerable to the impacts of climate change, the need for climate-friendly green technologies is extremely high in all South Asian countries. Unfortunately, technology transfer, mainly green technologies from developed countries to South Asian countries has been limited by the contentious issue of IPRs. Given the lack of green technology in South Asia, it is imperative for South Asian countries to explore new innovative ways to facilitate the transfer of greener technologies. In this regard, South Asian countries should leverage the skills and talent of their diaspora for technology development in the region by efficiently and successfully mobilizing diaspora resources.

Photo 40: 'The Brick Industry of South Asia is Dominated by Fixed Chimney Kilns

Photo Credit: Asha Kaji Thaku, ICIMOD

Box 31: Technology Transfer in South Asia

The brick industry is South Asia is based on traditional technologies like the fixed chimney kilns and clamps. Instances of modern technologies are virtually non-existent. These technologies are highly resource and energy intensive. The Vertical Shaft Brick Kiln technology has been transferred to several countries in South Asia.

Initially, this Chinese technology was transferred to Nepal, Bangladesh and Pakistan via donor agencies. However, it was unsuccessful owing to technical problems. Later on, the Swiss Development Cooperation (SDC) initiated an action research programme to transfer this technology to India. A pilot kiln was commissioned in Datia, Madhya Pradesh, India. After its success, another kiln was constructed in Kankia, Odisha with the help of Gram Vikas. This was followed by a technology transfer programme to Nepal and Vietnam in 2003. The activities for transfer to Afghanistan and Pakistan were initiated in 2006 and 2007.

Several other examples of technology transfers can be seen like that of energy efficient air conditioning by Hitachi to India.

Source: Heierli and Maithel (2008).

Several aspects need to be addressed for the effective development and transfer of technologies. Some of them include collaborative research, technology demonstrations, and access to information. The current emphasis on cleaner technologies has encouraged further research and innovation, leading to development of new products and technologies. While developed countries continue to lead in terms of innovating new technologies, developing countries like India are starting to make significant contributions. There is a need to build the capacities of South Asian countries to enhance R&D. Enhancing the knowledge of these countries is also essential to ensure the success of technology transfer. Cooperation among the member countries of the region could possibly reduce the cost 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 pivotal role in exchanging information, providing training programmes for capacity-building and networking with international organizations.

Commercialization of these technologies is also essential. The demonstration of such technologies will help in their adoption. Pilots of these technologies can act as demonstrable examples and generate awareness among people on the benefits of using such technologies. Public-private partnerships should also be promoted in the region as they play an important role in creating a critical mass of skills in developing countries to plan and implement technology-transfer projects.

The role of information in technology transfer is also crucial. Information sources should be easily accessible to the users. Information should be clear and specific to provide focused answers to why clean technology is needed, the existing technologies, their costs, benefits and drawbacks. Companies in the region face bigger obstacles when it comes to financing green technologies. These technologies are either unknown or not yet considered a feasible solution 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. Incentives for the development and dissemination of technologies can facilitate the technology transfer.

South-South Technology Transfer

The potential of South-South technology transfer needs to be fully explored. Countries in the region need to focus on sharing indigenous technologies. SAARC can act as a catalyst for technology transfer in the region. Mechanisms should be developed to encourage intra-region transfer. In order to strengthen South-South technology transfer, following measures could be adopted:

- Identifying technology needs of the region
- Initiating research and development through mutual support
- Establishing a South Asian Technology Bank
- Formulating agreements for technology-transfer across the region

The relevance of technology transfer, not only from an environmental perspective but also from a development one, underlines the need to develop the appropriate legal and financial mechanisms to support and encourage the diffusion of mitigation and adaptation technologies between developing countries. A range of barriers, IPR in particular, still exists but these challenges could be

overcome with the right common action. It is in the interest of the entire international community to adopt the appropriate instrument to regulate and facilitate the South-South exchange of climate-related technologies, and to make a significant contribution thereby to more effective protection of the environment.

6.4 Investment and Trade

The promotion of growth and the outlook for further reductions in poverty, through increased trade and investment and through deeper regional economic integration, hold much promise in South Asia. This is especially so now, since the region is increasing trade volumes and is moving towards a more outward economic orientation. It is important to enhance trade and investment by creating favourable micro-economic 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 also 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 liberalization and globalization. Similarly, business associations in the region also maintain their network links through the SAARC Chamber of Commerce and Industry and other alliances.

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 environment-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.

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 emission standards. While such approaches can be effective, conventional environmental policies have been widely criticized 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 low-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 instruments that can be distinguished

1. 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 promote incentives to reduce waste and pollution, while at the same time generating revenue which may be earmarked in certain instances for public environmental protection.

Carbon taxes on carbon intensive production processes or products are a market based mechanism to discourage the use of fossil fuels. They help induce a change in the behaviour of consumers with respect to renewable energy and energy efficiency. India has already imposed a carbon tax on coal at the rate of Rs. 50 per ton and generated funds for the National Clean Energy Fund (NCEF).

2. Tradable permits

Another option for South Asian 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 results in gradual reduction in pollution quotas (and thus emissions) over time.

3. 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 account of the potential impact of their operations, or stimulate insurers to charge higher premiums for environmentally-risky activities.

4. 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.

Box 32: Removing Fossil Fuel Subsidies in South Asia

In 2010, India announced that petrol pricing would be market driven. Immediate price increases were announced for diesel, liquefied petroleum gas (LPG) and kerosene. Natural gas pricing reform in 2010 allowed state-run producers to sell natural gas from new fields at market prices instead of regulated rates, and the price of natural gas more than doubled. In the coal industry, price reforms are expected to bring domestic prices in line with imports, allowing for quality differences, which will increase electricity prices. Pakistan also plans to phase out electricity subsidies and has implemented a 20 per cent tariff increase.

Source: UNEP (2012)

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.

Promotion of Sustainable and Responsible Business

National governments can promote sustainable and responsible business through Corporate Social Responsibility (CSR). Policy-makers should ensure that the profits from business don't come at the expense of society and the environment. Collaboration with the corporate sector will complement the efforts of the government of social and environmental advancement of the country. It will also attract foreign investment in a country (UNESCAP 2011).

In this context, efforts like Global Reporting Initiative (GRI) (www.globalreporting.org) and the Global Compact (www.unglobalcompact.org) initiated by the UN Secretary General need to be promoted. Attempts are being made to evolve more comprehensive monitoring and reporting mechanisms with the participation of a broader set of stakeholders. Flexibility should be provided to companies to tailor their corporate responsibility principles to local conditions of the country. They should also be involved in the decision-making process.

6.5 Promoting Ecosystem Based Adaptation (EBA)

The 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. This is especially true for the developing region of South Asia. Increasing demand for services due to population growth will put enormous pressure on the ecosystem. These countries will face large problems from ecosystem degradation. Overlaid will be the effects of growing pressures such as the species extinction, and increased incidence of droughts and floods from climate change. EBA involves the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse impacts of climate change. This means tackling problems with solutions based on nature. For example, a wetland system is utilized as a natural "sponge" to absorb flash floods coming down from the mountains, in order to protect farmers' fields.

One of the indirect drivers of ecosystem degradation is the lack of appropriate market value for the services provided

by them. Ecosystem Service Valuation (ESV) addresses this issue by integrating 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 understand the trade-offs better when altering natural ecosystems. The Economics of Ecosystem and Biodiversity (TEEB) can be used as a tool for valuation. This ecosystem-based approach should be integrated throughout the decision-making process. ESV also helps in determining innovative financing mechanisms that provide incentives to communities to remain engaged in conservation, which should be explored by countries since such monetary incentives provide a motivation to people to protect their habitats. Payment for ecosystem services (PES) is an effective instrument to deal with ecosystem degradation. PES is also helpful in addressing many of the drivers of biodiversity loss in the region, especially habitat fragmentation. It can also be used in conjunction with other policies and efforts like protected areas, integrated water resource management, sustainable forest management.

Valuation of ecosystems and financing mechanisms should be complemented by regular monitoring and assessment of ecosystem services and identifying trade-offs. It is also important to involve local communities in the decision-making process. Regular data collection and analysis is essential for informed decision making. Future ecosystem monitoring and assessment needs to draw on both traditional and scientific knowledge and emphasise the links between ecosystems and people. 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.

New technologies, such as web-based interfaces that display spatially referenced information on a virtual globe, provide ways to share, analyze, and disseminate information across different levels.

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.

Box 33: Restoration of Coastal Habitats as an Elective Measure against Storm Surges, Saline Intrusion and Coastal Erosion: Tree Walls as an Adaptation Strategy in the Sundarbans in West Bengal, India

Climate change is causing increased coastal erosion and saline water intrusion in the Sundarbans, the largest mangrove in the world (straddling India and Bangladesh). Increased salinity has reduced crop productivity and affected fish farming. Repeated occurrences of violent cyclones in the region have reduced livelihood options. After the devastating cyclone, Aila, of 2009, the local community recognized the role of ecosystem, based adaptation in responding to disasters and has started planting mangroves and tree walls as an adaptation strategy to withstand cyclones and violent storms. This has proved to be very effective. Other measures introduced after Aila are planting saline-resistant cereal and vegetable crops; maintaining non-shrimp brackish water fisheries; raising mangrove nurseries and plantations as an alternative livelihood option; food processing; and other non-farm activities.

Source: UNDP (2012)

Box 34: Reduced Emissions from Deforestation and Forest Degradation

Reduced Emissions from Deforestation and Forest Degradation (REDD) is trying to develop a market value for the services of forest ecosystems by creating a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forest lands and invest in low-carbon paths through sustainable development.

The concept of Reduced Emissions from Deforestation in Developing Countries (REDD) was introduced during the UNFCCC Conference of Parties (COP 11), held in 2005. It was further elaborated, expanded and officially adopted during COP 13 in Bali, Indonesia in 2007. The final "d" in REDD stands now for "degradation" as it was observed that forest degradation in some developing countries was as threatening as forest conversion. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

According to the Cancun Agreements, REDD+ will be implemented in three phases. Countries in South Asia are still in Phase I (also call the REDD readiness phase), which comprises the development of national strategies or action plans, policies and measures, and capacity development. This will then be followed by the implementation of national policies and measures and national strategies or action plans (Phase II) and results-based demonstration activities, and evolving into results-based actions that should be fully measured, reported and verified (Phase III).

Jointly implemented by FAO, UNDP and UNEP, the UN-REDD Programme is supporting national REDD+ readiness efforts in 53 partner countries, of which five are located in South Asia. UN-REDD partner countries in South Asia include Bangladesh, Bhutan, Nepal, Pakistan and Sri Lanka (only Sri Lanka has currently a full National UN-REDD Programme, other countries receive targeted support).

Sri Lanka's UN-REDD National Programme started in early 2013 and with duration of three years. Nepal REDD+ readiness efforts are supported by the Forest Carbon Partnership Facility (FCPF). Bhutan expects the similar support during 2014. It is currently receiving UN-REDD Programme support for developing a national approach to safeguards and a national forest monitoring system. Bangladesh is expected to start its UN-REDD National Programme at the end of 2014 or early in 2015. Pakistan is applying for FCPF support. The Government of India has set up a REDD+ cell in MoEF&CC to coordinate and guide REDD plus related actions at national level and to discharge the role of guiding, and collaborating with the State Forest Departments (SFDs) to collect, process and manage all relevant information and data relating to forest carbon accounting. It would also guide formulation, development, funding, implementation, monitoring and evaluation of REDD+ activities in the States. In comparison to other regions, South Asia REDD readiness efforts are less advanced and none of the countries has prepared a National REDD+ Strategy.

Getting ready for REDD in South Asia faces several challenges, such as poor awareness about REDD+, weak cross-ministerial coordination and only embryonic private sector involvement. In addition, in many countries REDD+ is viewed as a forestry project, while key drivers are often also in other sectors, such as agriculture and the unfulfilled high expectations of "billions of dollars" has led to some fatigue of getting ready. On the other hand, there has been some progress developing national forest monitoring systems, government agencies have started to actively engaging civil society and indigenous peoples' representatives in planning processes and safeguards are beginning to receive serious attention.

Photo 41: Local People Participating in REDD+ Project in Dolakha, Nepal

Photo Credit: Eak B. Rana, ICIMOD

6.6 Establish a Regional Environmental Data and Information Management System

Monitoring and evaluation of the state of environment of the region requires accurate information. Such science-based assessment on the trends of environment is vital for effective decision and policy making. Lack of accurate information hampers the formulation and implementation of appropriate policies/schemes. Scattered information and data, and lack of tools, technical expertise and resources have also limited the decision-making in the region. Compilation of environmental statistics, tables, interactive maps and text at one place will provide easy access to spatial and statistical information.

In order to address this issue, a few countries have already developed national level databases and information systems for environmental data management and some are beginning to initiate similar processes. However, the data sharing mechanisms remain weak and information networking and coordination among the line agencies for effective data sharing is simply non-existent. Quality of data is also a concern in the region. Data sharing mechanisms among the countries should also be strengthened to address trans-boundary issues.

Lack of capacity to conduct and sustain the Integrated Environment Assessment (IEA) and reporting systems poses many challenges in south Asia. There is a distinct dearth of capacity to handle data collection, compilation, analysis and interpretation for SoE reporting, along with non-responsiveness of various organizations involved in environmental monitoring. In order to support informed environmental decision-making, capacity building of national and regional organizations is the need of the hour.

Given that many countries do not have the capacity or size to sustain long term monitoring and data management programmes, a strong regional data management mechanism is essential. A regional environmental and information system should be developed containing statistics, text, tables and interactive maps of all related sectors. Institutional, technical and financial options should be considered for the establishment of such a system. For the development of web pages, a user interface, administrative panel and a back-end application should be designed. A common template should be developed for all the countries for easy and uniform data collection. Data can be collected and collated with the help of the Drivers-Pressure-State-Impacts-Responses (DPSIR) framework. Also, environmental data can be depicted through geographic information system (GIS) for better visualization.

A focal point has to be indentified for the data collection process, which will collaborate with various national level institutions like academic institutions, research organizations, government ministries, statistical departments etc. Funding can be acquired from various regional and global donor agencies.

6.7 Improved Environmental Governance

Environmental governance at the national, regional and global level is critical for sustainable development of the region. Strengthened environmental governance is extremely crucial to effectively address the emerging environmental challenges and priorities of the region. Effective national governance also complements the efforts at the international platforms. In short, without effective environmental governance, it is difficult to realize our aspirations of sustainable development. Governments, inter-governmental and non-government organizations, civil society, private sector and other actors, individually or collectively, play a vital role in environmental governance.

South Asia has a wide diversity of systems and mechanisms for collective decision-making. However, as "remain centralized, expert-driven, compartmentalized, and inflexible". A persistent problem is the ineffective implementation of the environmental laws, action plans and programmes.

Policy Integration and Mainstreaming

It is critical to integrate the vision of sustainable development in the planning process of the region. This requires proper coordination between different ministries and agencies involved in the process of planning and implementation of various related policies. Capacity building of environment and related ministries and agencies for mainstreaming of sustainable development is the need of the hour. Proper capacity building and increased policy integration is the winning formula for sustainable development in the region. This integration would not only strengthen the decision-making influence of environment ministries, but also enhance accountability regarding the potential environmental and social impacts of development projects. Integration should be supported by impact assessment and monitoring to build credible scientific evidence in support of mainstreaming. Environment impact assessment (EIA) of projects along with strategic environment assessment for policies, plans or schemes.

Box 35: Climate Public Expenditure and Institutional Review in Bangladesh

The Government of Bangladesh is working with PEI to develop a sophisticated climate change accounting system. Until recently, the Government had no way of tracking its expenditure on climate change adaptation across all its departments, making it near impossible to assess the effectiveness of their policies. Since climate change expenditure was rising in the country, the Ministry of Finance launched the 'Climate Public Expenditure and Institutional Review' in collaboration with PEI. The review analyzed spending by the Local Government Division to identify climate change expenditure at local levels. The review tracked spending on climate change across 37 different departments and assessed 13,000 budget codes. The vast majority of climate funding is embedded within multi-dimensional programmes across numerous government departments. Taken together, Bangladesh currently spends US$1billion a year, 6-7 per cent of its annual budget, on climate change adaptation.

The budget tracking process is part of a wider strategy, now being spearheaded by the Ministry of Finance to introduce a 'Climate Change Fiscal Framework'. The approach will allow the government to track the demand and supply for funds associated with climate change, as well as the sources of funds available from domestic and external sources. In short, it will provide a live checking account for climate change costs.

Source: www.unpei.org

Some degree of mainstreaming is practiced in the region. There are several examples of climate change risks being incorporated into existing policies, programmes or decision-making processes related to resource management, community development, livelihood enhancements, sustainable development and risk management in India. The benefits of mainstreaming include a more inclusive policy formulation process, greater coherence of policies, proper implementation and an increased ability of the community to cope with the ever-increasing environmental challenges. The UNDP-UNEP led Poverty Environment Initiative (PEI) supports the efforts of various countries to mainstream poverty-environment linkages into national development and sub-national development planning. PEI programme is active in Bangladesh, Bhutan and Nepal in South Asia. The programme supports central and local governments in these counties to integrate ecological, climate and fairness concerns in planning and budgeting processes to achieve a greener and more inclusive economy. This initiative should be introduced in other countries of the region as well. This also requires more budgetary allocation and coordinated efforts for proper implementation.

Mainstreaming of the sustainable development vision should be supported by decentralisation. Decentralised decision-making is an important condition for addressing environmental problems. Decentralisation refers to a process through which authority and responsibility for some functions are transferred from the central governments to more appropriate levels like the local governments, communities or even the private sector. Decentralisation in decision-making should be promoted as local institutions and communities have a better understanding of the issues in the area. It would also facilitate the participation of the local community in the decision-making process, ensuring higher transparency. Proper delegation of authority should also be linked with suitable budgets, human resources, capacity building and monitoring mechanisms to ensure effectiveness.

Civil society organizations (CSOs) and networks, including community based organizations and non-governmental agencies, play a major role in mobilizing the governments of South Asian countries to take up a just cause through advocacy. They could also put forth their views on various other platforms and networks. The research findings of various CSOs should be disseminated to a wider audience. They could also be effective agents for governance at the local, regional, national and global level and assist the

governments in planning, implementation and monitoring of activities. There are quite a few regional initiatives by the civil society that have a bearing on sustainable development in the region. These include South Asian Forum for Environmental Journalists, Climate Action Network South Asia (CANSA), Regional and International Networking Group (RING-South Asia), Community Led Action Network (CLEAN-South Asia), South Asia Alliance for Poverty Eradication, South Asia Watch on Trade, Economics and Environment (SAWTEE) and South Asia Youth Environment Network. Such institutions need to nurtured and encouraged in order to achieve sustainable development.

E-Governance

Electronic governance or e-governance refers to the use of Information and Communication Technology (ICT) to carry out the activities and operations of the government more efficiently. Use of ICT to carry out the activities and operations of the government enables better utilization of resources and reduces the financial costs. It provides a platform for interaction between the government and common citizens. It also ensures wider participation of citizens, CSOs and other stakeholders in the governance system. It can also be used to monitor the progress of various schemes introduced by the government. Utilizing e-governance can be the key to the integration of economic, social and environment goals for development planning.

Box 36: E-Governance in India

India has made a steady progress in terms of utilization of ICT for better governance. The formulation of National e-Governance Plan (NeGP) by the Department of Electronics and Information Technology (DEITY) and Department of Administrative Reforms and Public Grievances (DAR&PG) in 2006 has boosted the e-Governance process. NeGP attempts to make all Government services accessible to the common man in his or her locality, through Common Service Centres (CSC) which are being set up all across India. As on August 31, 2013, about 1, 27,002 CSCs became operational with different brand names and started delivering services to people.

In addition to the national portal, the Government has also developed an India Development Gateway. This was developed as a single-window access to information and services, with the specific objective of reaching the rural communities of India, especially women and the poor. It catalyzes the use of ICT tools for knowledge-sharing, leading to sustainable development. This variant of the national portal contains information on specific topics like agriculture, health, rural energy, primary education and social welfare. It also features discussion forums. Making this information tool available in English and in eight local dialects, the Government's main objective is to stimulate women, the poor, and people in remote rural areas to use technology to their own advantage.

Source: www.india.gov.in, UNDESA 2012

6.8 Promoting Regional Cooperation

Regional cooperation plays a critical role in the sustainable development of any region. As the economies of the countries become interconnected, it helps in accelerating economic growth, reducing poverty and economic disparity and raising the employment opportunities. Addressing the trans-boundary issues is not possible without regional integration at the political, business, knowledge and technological level. In the present times, a number of countries are aligning themselves either regionally or economically with each other to form a grouping. In the South Asian region, the efforts of SAARC and SACEP have been simply commendable.

Table 43: Regional Policies and Programmes in South Asia

Themes	Regional Cooperation Efforts
Climate Change	SAARC Action Plan on Climate Change
	Dhaka Declaration on Climate Change
	Thimpu Statement on Climate Change
	SAARC Disaster Management Centre
	SAARC Meteorological Research Centre
	SAARC Coastal Zone Management Centre
	South Asia Network for Security and Climate Change
Food Security	SAARC Agriculture Centre
	South Asia Preferential Trade Area
	South Asia Free Trade Agreement
	SAARC Food Bank
Water Security	South Asia Water Initiative
	South Asian Water Analysis Network
Biodiversity	SAARC Forestry Centre
	South Asia Coral Reef Task Force
	South Asia Seas Programme
	South Asia Wildlife Enforcement Network
	South Asia Biodiversity Clearing House Mechanisms
	Mangroves for Future
	Strengthening Regional Cooperation for Wildlife Protection Project
Air	Malé Declaration on Control and Prevention of Air Pollution and its likely Trans-boundary Effects for South Asia
	Partnership for Cleaner Fuels and Vehicles
Energy	SAARC Energy Centre
Waste	International Partnership for Expanding Waste Management Services of Local Authorities
Others	South Asia Watch on Trade, Economics and Environment
	SAARC Documentation Centre
	SAARC Information Centre

Even though a number of initiatives have been undertaken by SAARC and SACEP for facilitating South Asian cooperation, they still lack adequate implementation arrangements. Most of them don't even have robust institutional arrangements to pursue their mandates. Therefore, in order to enhance South Asian cooperation, the implementation systems at the regional level should be strengthened. And, appropriate human resource and infrastructure should be committed to strengthen these initiatives.

Sharing of best practices with respect to policies, programmes and schemes among countries is a must. Such practices could also be replicated by other nations. Some successful interventions could be the GNH of Bhutan, Mahatma Gandhi National Rural Employee Guarantee Act of India and others. In order to facilitate this, common interest hubs comprising academicians, researchers and all kinds of experts should be formed to look into the environmental concerns. These hubs could play a vital role in providing solutions and advising the governments of all nations on the significant issues of environment.

Box 37: Mahatma Gandhi National Rural Employment Guarantee Act 2005

India's Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) is a guaranteed wage employment programme that enhances the livelihood security of marginalized households in rural areas. It provides 100 days of guaranteed wage employment in a financial year to every rural household whose adult members volunteer to do unskilled manual work. Implemented by the Ministry of Rural Development, NREGA directly touches the lives of the poor, promotes inclusive growth, and also contributes to the restoration and maintenance of ecological infrastructure. Some of the developmental activities implemented through MNREGS initiatives include construction of ponds, percolation tanks, afforestation, de-silting, drought prevention, flood management, village road, macro and micro initiative works, etc. One of the major objectives of NREGA is to strengthen rural natural resource management. This is achieved by financing rural works that address the causes of drought, deforestation and soil erosion, thus restoring the natural capital base on which rural livelihoods depend.

Water conservation accounts for about half of the total projects supported under NREGA, with 850,000 water conservation works funded and completed from 2006 to 2008. For example, in Andhra Pradesh, NREGA supported the restoration of a network of water storage tanks dating back over 500 years in the principal arid zone. Repairs to the gates of the tanks, as well as works to de-silt the channels feeding them, has restored to full capacity. This has not only boosted the crop and livestock production, but has also contributed to groundwater replenishment.

In its short history, NREGA has produced many such success stories across the country. In terms of promoting inclusive growth and restoration of ecological infrastructure, the programme has made a strong impact in terms of empowerment of poor and marginalized groups. It has contributed in terms of boosting the average wage for agricultural labourers for more than a quarter over its three- year history.

Source: http://www.unep.org/greeneconomy/SuccessStories/RuralEcologicalInfrastructureinIndia/tabid/29868/Default.aspx

6.9 Transition towards a Green Economy

UNEP defines a green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". In a green economy, growth in income and employment is driven by public and private investments that reduce carbon emissions and pollution; enhance energy and resource efficiency; and, prevent the loss of biodiversity and ecosystem services. Keeping in mind the increasing environmental concerns of the region, the emerging concept of green economy is particularly relevant. Basically, sustainable development and green economy are the two sides of the same coin. And, attaining the ultimate goal of sustainable development will be possible only through greening the economy. A green economy is also central to poverty alleviation in the region. It seeks to provide diverse opportunities for economic development and poverty alleviation, without liquidating or eroding the country's natural resource base. This is particularly necessary in low-income countries of South Asia, where ecosystem goods and services form a large component of the livelihoods of poor rural communities. Such economic development would also enhance social equity through creation of sustainable livelihoods and promotion of entrepreneurship.

It can be concluded that for effective implementation of the polices and attainment of sustainable development, there is a need for mainstreaming adaptation in planning and development agendas for ensuring efficient environmental governance, where coordination between institutions (including donors, governments, state level agencies, and other local partners) needs to be set up. In addition to this, all mechanisms should be transparent with regular monitoring and evaluation in consultation with the stakeholders at all levels. There is also a need for building and activating data and information systems, capacity development of the stakeholders and institutional strengthening, enabling them to understand and exhibit quick response among them to tackle priority issues like water, energy, and food security.

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Photo Credit: Asha Kaji Thaku, ICIMOD

Photo Credit: Development Alternatives

Annexures

Annexure 1:
List of Participants of Inception & Training Workshop

Annexure 2:
List of Participants of Consultation Workshop

Annexure 1: Inception and Training Workshop

Inception and Training Workshop for
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Annexure 2: Consultation Workshop

Consultation Workshop for Preparation of South Asia Environment Outlook 2013

28-29th May, 2013 Kathmandu, Nepal

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